

# Arrow Vision Series

## WEBENCH® Power Architect

### Multi-Rail Power Supply Design In Minutes!

# Objectives



WEBENCH® Overview



Efficiency Calculation and Design Optimization



Electrical and Thermal Simulation



Build it and Reporting

# 13 Years of Modeling and Verification

Faster & More Effective

Offline Past



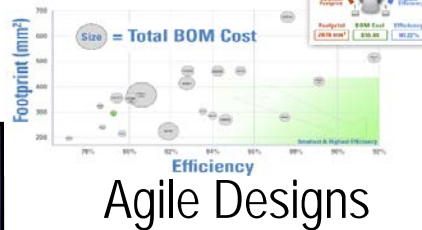
Trial and Error

1999 Online

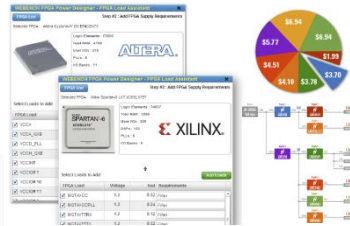


WEBENCH®  
Design Tools

2009 Visualizer



2010 FPGA  
Power Architect



Agile Systems

2012 FPGA System  
Power Architect



Complete Systems

New Capabilities

# WEBENCH<sup>®</sup> Tools

**Power Designer**

Power supply and system power architecture

**LED Designer**

LED driver design and LED architecture

**Sensor Designer**

Sensor analog front end design

**Active Filter Designer**

Filter design and simulation

**PLL Designer**

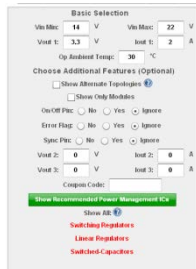
PLL implementation

**Amplifier Designer**

Op amp design and simulation

# Beginning to end: Design and Prototyping

## 1. Choose a Part

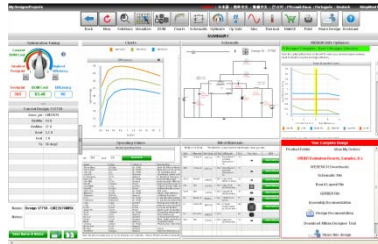


Enter Specifications



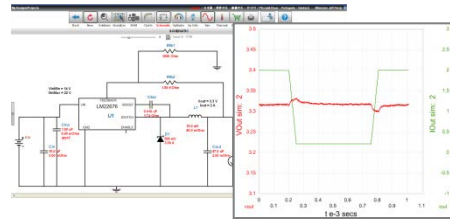
Select Part

## 2. Create a Design

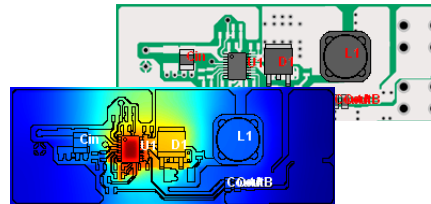


Optimize for Footprint and Efficiency, Use Graphs to Visualize Design

## 3. Analyze a Design



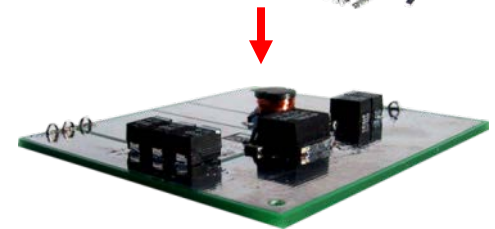
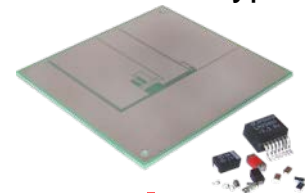
Generate Schematic/  
Electrical Analysis



Generate Layout/  
Thermal Analysis

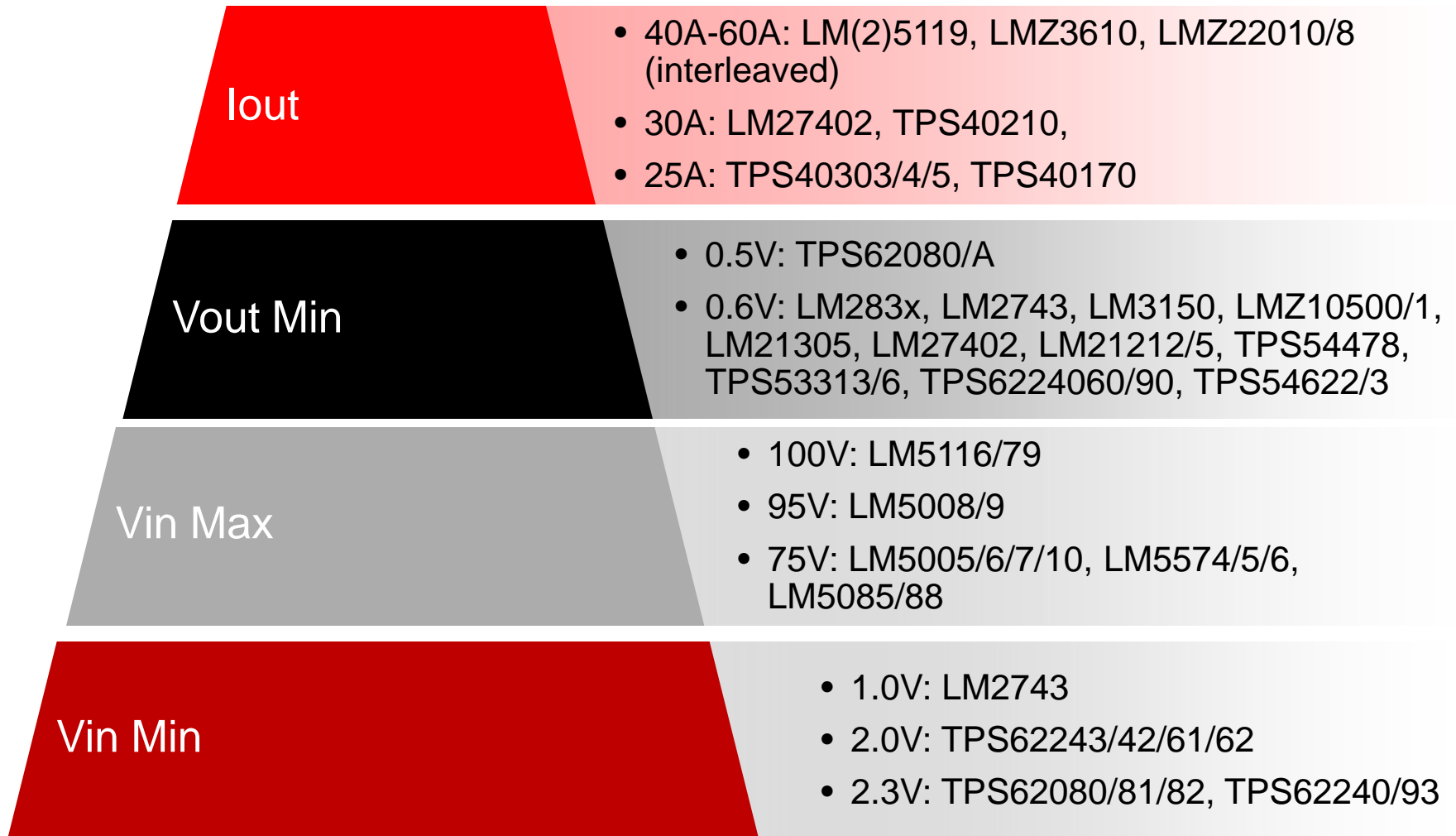
## 4. Build It!

Schematic Export  
Custom Prototype Kit



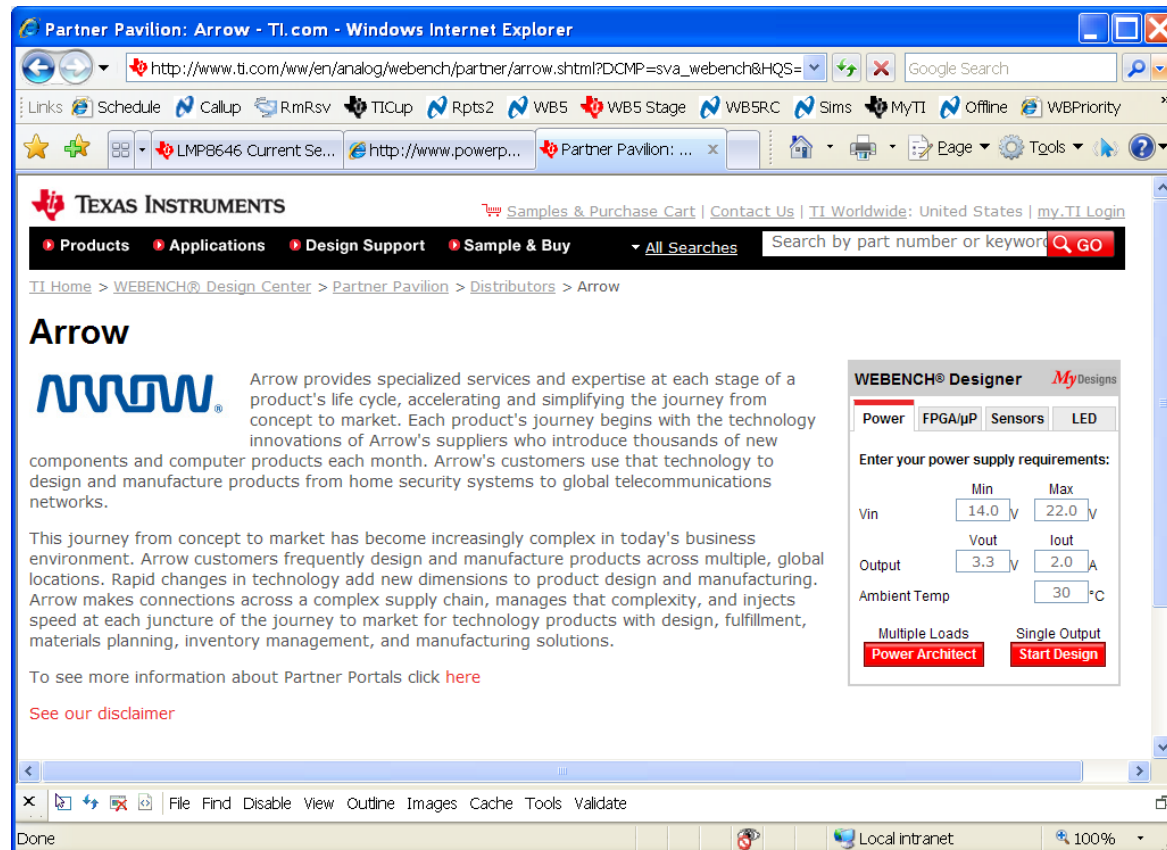
Prototype

# Coverage of WEBENCH<sup>®</sup> enabled parts (Buck Switchers)



# Arrow WEBENCH Designer

- Access customized versions of WEBENCH® Designer:
- <http://ti.com/arrow>



# Ways to Access WEBENCH® Designer

The screenshot displays the Texas Instruments website with the WEBENCH® System Power Architect and WEBENCH® Designer interfaces. The top navigation bar includes links for Products, Applications, Tools & Software, Support & Community, Sample & Buy, and About TI, along with a search bar. The main content area features a sidebar with product categories and a central panel for the WEBENCH® Designer. The designer panel includes tabs for Power, FPGA/μP, Sensors, and LED, and a form for entering power supply requirements.

**WEBENCH® System Power Architect**  
Advanced design tool for power management including hot-swap controllers.  
Start your design today for free

**WEBENCH® Designer**

Power | FPGA/μP | Sensors | LED

Enter your power supply requirements:

	Min	Max
Vin	14.0 V	22.0 V
Vout	3.3 V	2.0 A
Ambient Temp		30 °C

Multiple Loads | Single Output

**Power Architect** | **Start Design**

- Use the entry panel on:  
<http://www.ti.com>
- Select the specific tool
  - Power
    - Power Architect
    - Start Design
  - FPGA/μP
  - Sensors
  - LED

# Ways to Access WEBENCH® Designer

**TEXAS INSTRUMENTS**

Products Applications Design Support Sample & Buy

Search by part number or keyword **GO**

TI Home > Semiconductors > Power Management > Switching Regulator > DC/DC Converter (Integrated Switch) > Step-Down Regulator >

LM22672  
(ACTIVE) 1A SIMPLE SWITCHER®, Step-Down Voltage Regulator with Features

No reviews yet. [Add your review and give us feedback.](#)

Description & Features Sample & Buy Technical Documents Tools & Software Support & Community

## Datasheet

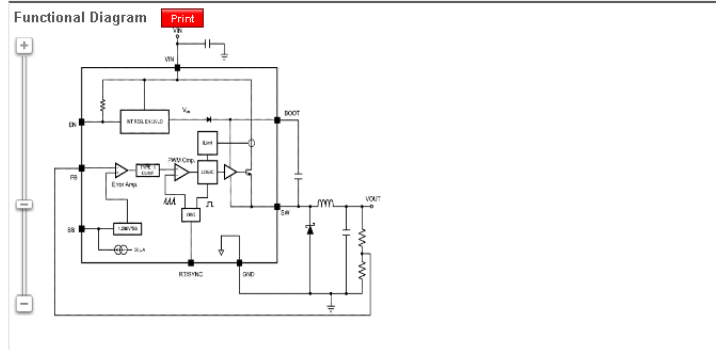
 [LM22672/2Q 42V, 1A SIMPLE SWITCHER Step-Down Regulator with Features \(Rev. K\)](#)  
(PDF, 447 KB) 08 Jun 2012

[View All Technical Documents](#)

## See Also

- > [LM22670](#) - 3A, Features Adjustable Switching Frequency Or Frequency Sync Up To 1MHz And Precision Enable
  - > [LM22671](#) - 0.5A Version
  - > [LM22673](#) - 3A, Features Adjustable Soft-Start And Adjustable Current Limit
- [View All](#)

## Diagrams (3)



## Featured Tools and Software

- > [LM22671 1A SIMPLE SWITCHER Regulator w/ Freq Adj or Synch and Precision Enable EVM](#) (Evaluation Modules & Boards)
  - > [LM2267x, LM22680 Quick Start Simple Switcher Component Calculator](#) (Calculation Tools)
  - > [Power Stage Designer of Most Commonly Used Switchmode Power Supplies](#) (Circuit Design & Simulation)
- [View All](#)

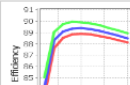
**WEBENCH® LM22672**

	Min	Max	Range
Vin	11.00	13.00 V	4.50 – 42.00V
Vout	5.00	V	1.28 – 37.00V
Iout	1.00	A	≤ 1.00A
Ambient Temp	30	°C	≤ 100°C

Lowest BOM Cost | Smallest Footprint | Highest Efficiency

Footprint: 207 | BOM Cost: \$2.43 | Efficiency: 87%

[Open Design](#)



OR

- Go to the product folder for a specific part
- Enter your specifications

# WEBENCH® Navigation

Navigation Icons

WEBENCH Tools:

Power

LED

LED Architect

Power Architect

FPGA / Processor

Power Architect

HotSwap

The screenshot displays the WEBENCH navigation interface. At the top, there are four icons: a red circular arrow labeled 'New', a magnifying glass labeled 'Solutions', a grid with a cursor labeled 'Visualizer', and a question mark labeled 'Assistant'. Below these is a grey bar with the text 'ENTER REQUIREMENTS'. Underneath this bar are six tabs: 'Power', 'LED', 'LED Architect', 'Power Architect', 'FPGA/μP', and 'HotSwap'. The 'Power' tab is selected. The main content area is titled 'Basic Selection' and contains several input fields: 'Vin Min: 14 V', 'Vin Max: 22 V', 'Vout 1: 3.3 V', 'Iout 1: 2 A', and 'Op Ambient Temp: 30 °C'. Below these is a section titled 'Choose Additional Features (Optional)' with checkboxes for 'Show Alternate Topologies' and 'Show Only Modules'. There are also radio button options for 'On/Off Pin', 'Error Flag', and 'Sync Pin', each with 'No', 'Yes', and 'Ignore' choices. At the bottom of this section are three more input fields: 'Vout 2: 0 V', 'Iout 2: 0 A', 'Vout 3: 0 V', and 'Iout 3: 0 A'. A 'Coupon Code' field is also present. A green button labeled 'Show Recommended Power Management ICs' is at the bottom. Below the button are three red links: 'Switching Regulators', 'Linear Regulators', and 'Switched-Capacitors'.

New Solutions Visualizer Assistant

ENTER REQUIREMENTS

Power LED LED Architect Power Architect FPGA/μP HotSwap

Basic Selection

Vin Min: 14 V Vin Max: 22 V

Vout 1: 3.3 V Iout 1: 2 A

Op Ambient Temp: 30 °C

Choose Additional Features (Optional)

☐ Show Alternate Topologies ?

☐ Show Only Modules

On/Off Pin: ☐ No ☐ Yes ☒ Ignore

Error Flag: ☐ No ☐ Yes ☒ Ignore

Sync Pin: ☐ No ☐ Yes ☒ Ignore

Vout 2: 0 V Iout 2: 0 A

Vout 3: 0 V Iout 3: 0 A

Coupon Code:

Show Recommended Power Management ICs

Show All: ?

Switching Regulators

Linear Regulators

Switched-Capacitors

# WEBENCH® Visualizer- Calculates 65 Designs in Seconds

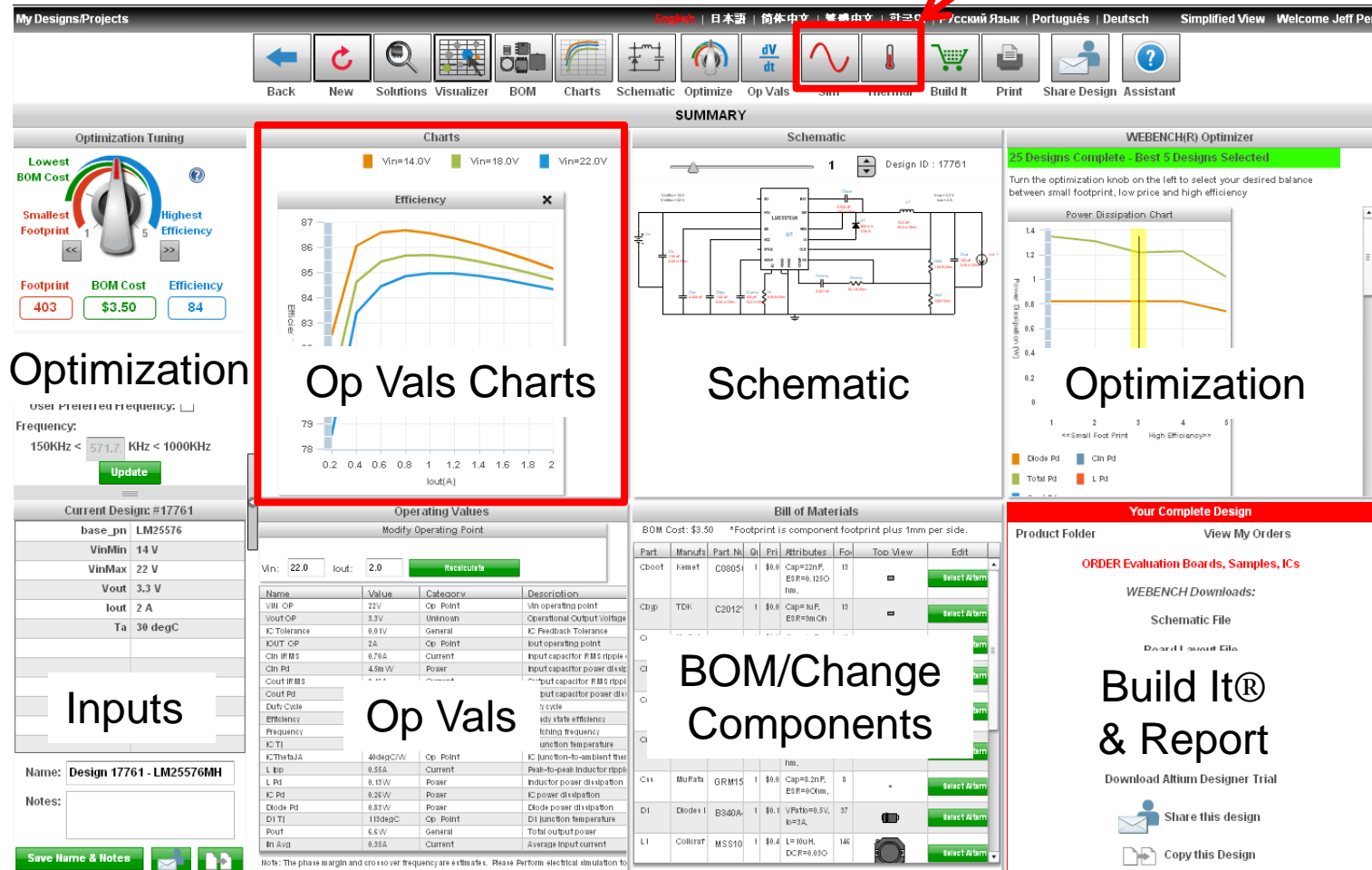


# Create and View Design

## Simulation

### Dashboard

- 1) Graphs
- 2) Schematic
- 3) Optimization
- 4) Operating values
- 5) BOM
- 6) Reporting



# WEBENCH® Optimizer Dial

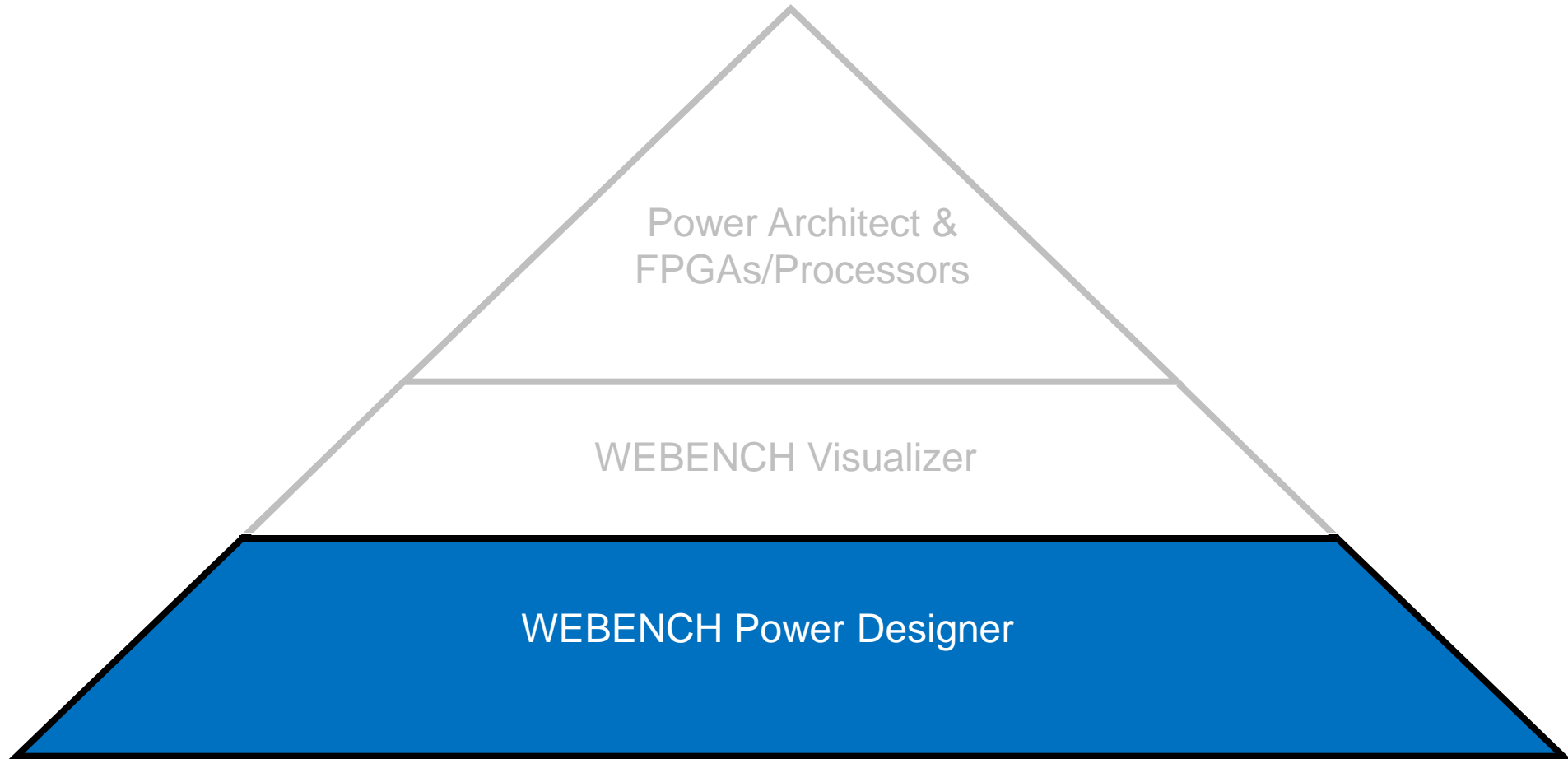
## “Dial In Your Solution”

# WEBENCH® Design Optimization

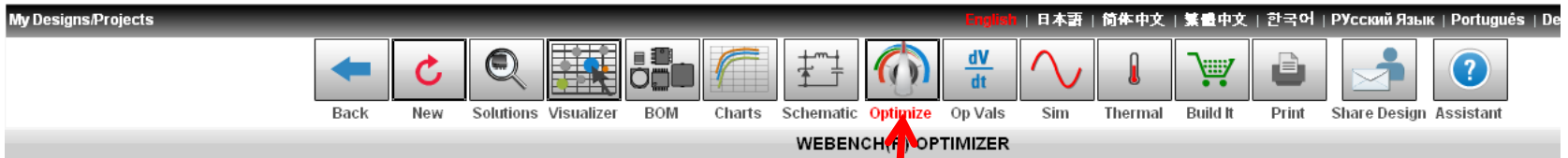


Optimization Setting	Frequency	Component Selection	Summary
<b>1 – Smallest footprint</b>	<b>Highest</b>	<ul style="list-style-type: none"> <li>• Smallest footprint</li> <li>• Don't care about cost</li> </ul>	Smallest size but lowest efficiency
<b>2 – Lowest cost</b>	<b>High</b>	<ul style="list-style-type: none"> <li>• Lowest cost</li> </ul>	High frequency means smaller / cheaper components
<b>3 – Balanced</b>	<b>Medium</b>	<ul style="list-style-type: none"> <li>• In stock</li> <li>• Low cost</li> </ul>	Balanced approach using IC's middle frequency
<b>4 – High efficiency</b>	<b>Low</b>	<ul style="list-style-type: none"> <li>• Low DCR, ESR, Vf</li> <li>• Low cost</li> </ul>	Higher efficiency, with low cost but larger parts
<b>5 – Highest efficiency</b>	<b>Lowest</b>	<ul style="list-style-type: none"> <li>• Low DCR, ESR, Vf</li> <li>• Don't care about cost</li> </ul>	Highest efficiency but largest parts

# The WEBENCH® Power Tool Suite



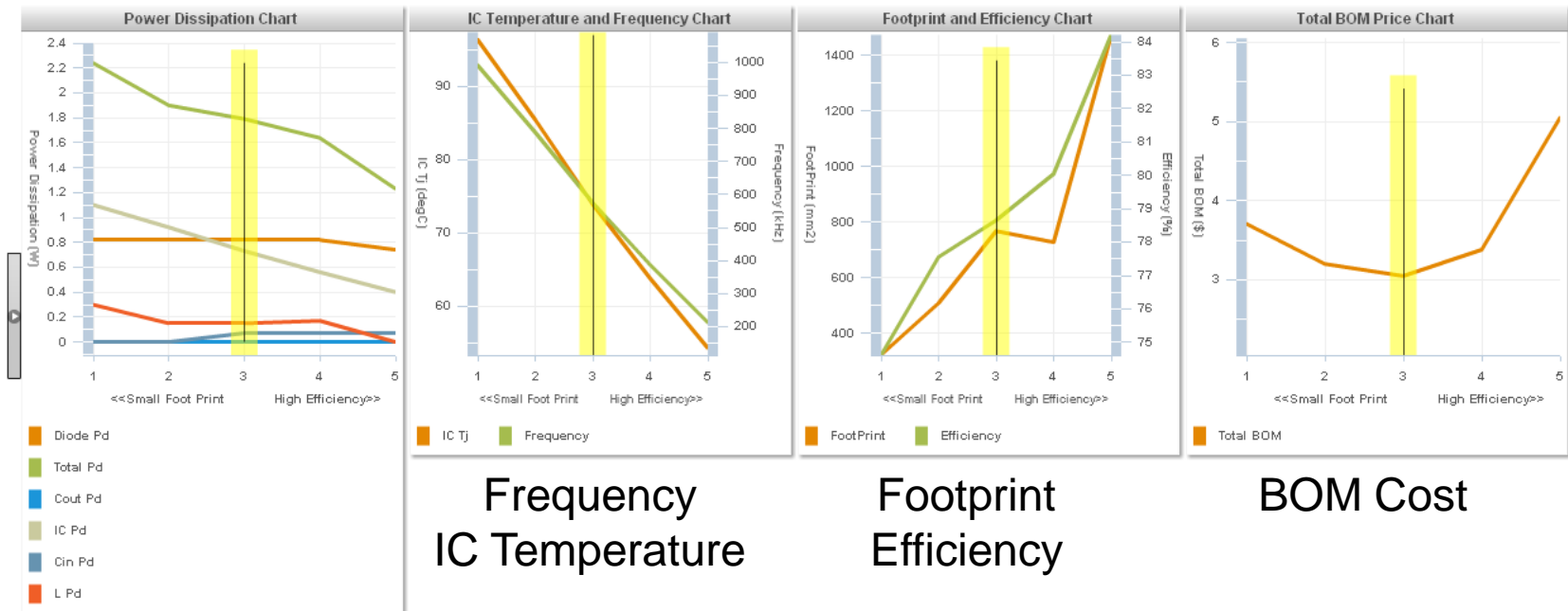
# Key Optimization Parameters Graphed



25 Designs Complete - Best 5 Designs Selected

Turn the optimization knob on the left to select your desired balance between small footprint, low price and high efficiency

Optimize page



Power Dissipation  
by Component

Frequency  
IC Temperature

Footprint  
Efficiency

BOM Cost

# Continue to Improve Each Design: View and Change Your Bill of Materials

Click Select Alternate To Change A Component

**My Designs/Projects** English | 日本語 | 简体中文 | 繁體中文 | 한국어 | Русский язык | Português Welcome Phil Gibson

Back New Solutions Visualize BOM Charts Schematic Optimize Op Vals Sim Print Share Design Assistant

**BILL OF MATERIALS**

Export to: ☒ Excel BOM Cost: \$3.50 \*Footprint is component footprint plus 1mm per side.

Part	Manufacturer	Part Number	Quantity	Price	Attributes	Footprint	Top View	Edit
Cb	MuRata	GRM155R71E333	1	\$0.01	Cap=33nF, ESR=00hm, VDC=25V	8	-	Select Alternate Part
Cbyp	TDK	C2012Y5V1E1052	1	\$0.01	Cap=1uF, ESR=9m0hm, VDC=25V	13	-	Select Alternate Part
Cin	TDK	C5750X7R1H1061	1	\$0.68	Cap=10uF, ESR=3m0hm, VDC=50V	60	-	Select Alternate Part
Cinx	Kemet	C0805C104K5RA	1	\$0.01	Cap=100nF, ESR=0.0640hm, VDC=50V	13	-	Select Alternate Part
Cout	TDK	C3225X5R054501	1	\$0.39	Cap=100uF, ESR=2m0hm, VDC=25V	23	-	Select Alternate Part
Css	MuRata	GRM155R71E123	1	\$0.01	Cap=12nF, ESR=00hm, VDC=25V	8	-	Select Alternate Part
L1	Bourns	SRU8043-6R8Y	1	\$0.36	L=6.8uH, DCR=0.0220hm, IDC=3.8A	100	-	Select Alternate Part
Rfb1	Vishay-Dale	CRCW0402976RF	1	\$0.01	Resistance=9760hm, Tolerance=1%, Power=0.063W	8	-	Select Alternate Part
Rfb2	Vishay-Dale	CRCW04023K09F	1	\$0.01	Resistance=3.09K0hm, Tolerance=1%, Power=0.063W	8	-	Select Alternate Part
Ron	Vishay-Dale	CRCW040246K4F	1	\$0.01	Resistance=46.4K0hm, Tolerance=1%, Power=0.063W	8	-	Select Alternate Part
U1	Texas Instrument	LMR24220TL	1	\$2.00		25	-	

**Optimization Tuning**

Lowest BOM Cost | Smallest Footprint | Highest Efficiency

272 | \$3.50 | 85

Advanced Options

Soft Start Time (ms): 1ms < 1 ms < 10ms

User Preferred Frequency: ☐

Frequency: 100KHz < 585.2 KHz < 1000KHz

Update

Current Design: #1523

Parameter	Value
base_pn	LMR24220
VinMin	14 V
VinMax	22 V
Vout	3.3 V
Iout	2 A
Ta	30 degC

Name: Design 1523 - LMR24220TL

Notes:

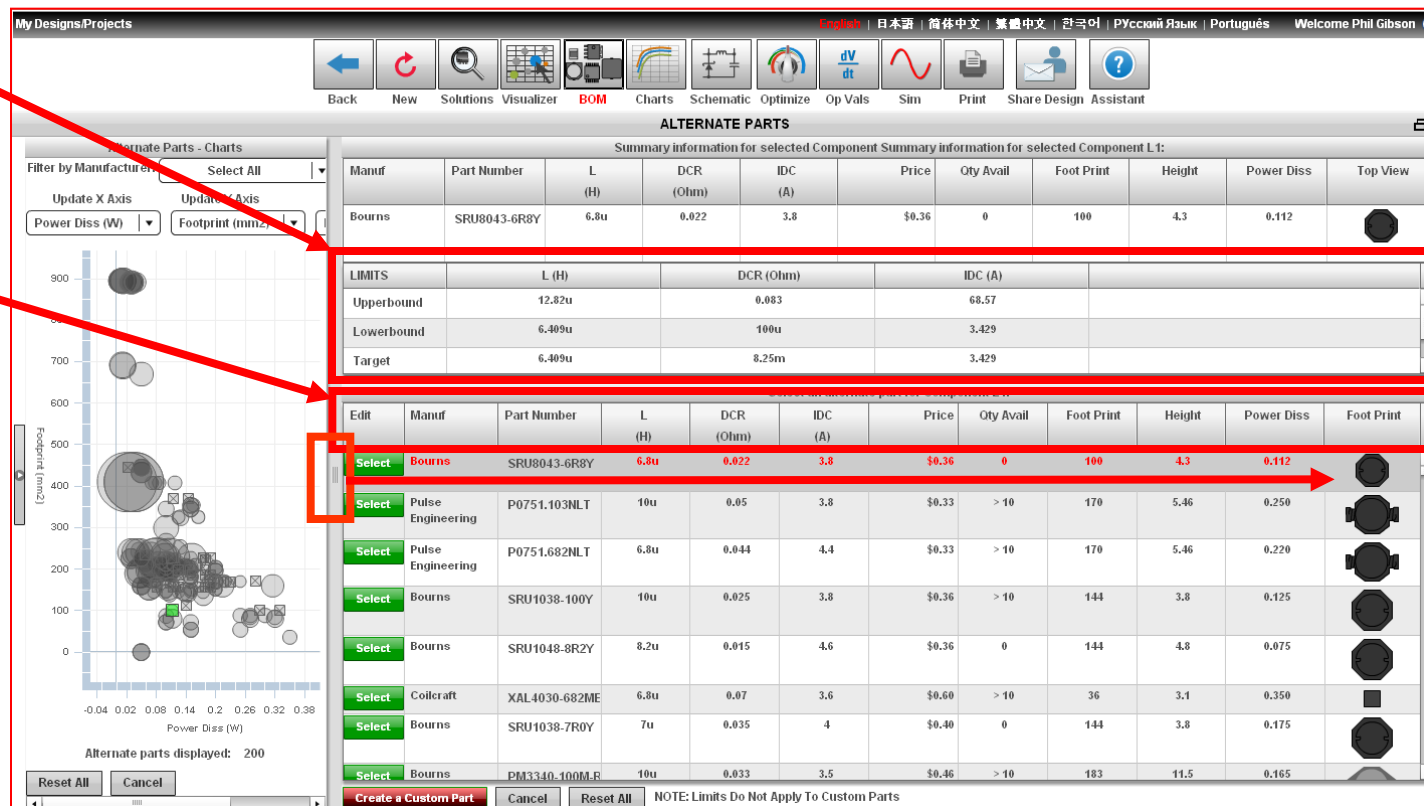
Save Name & Notes

# Evaluate and Select Alternate Components for Each Rail in the Design

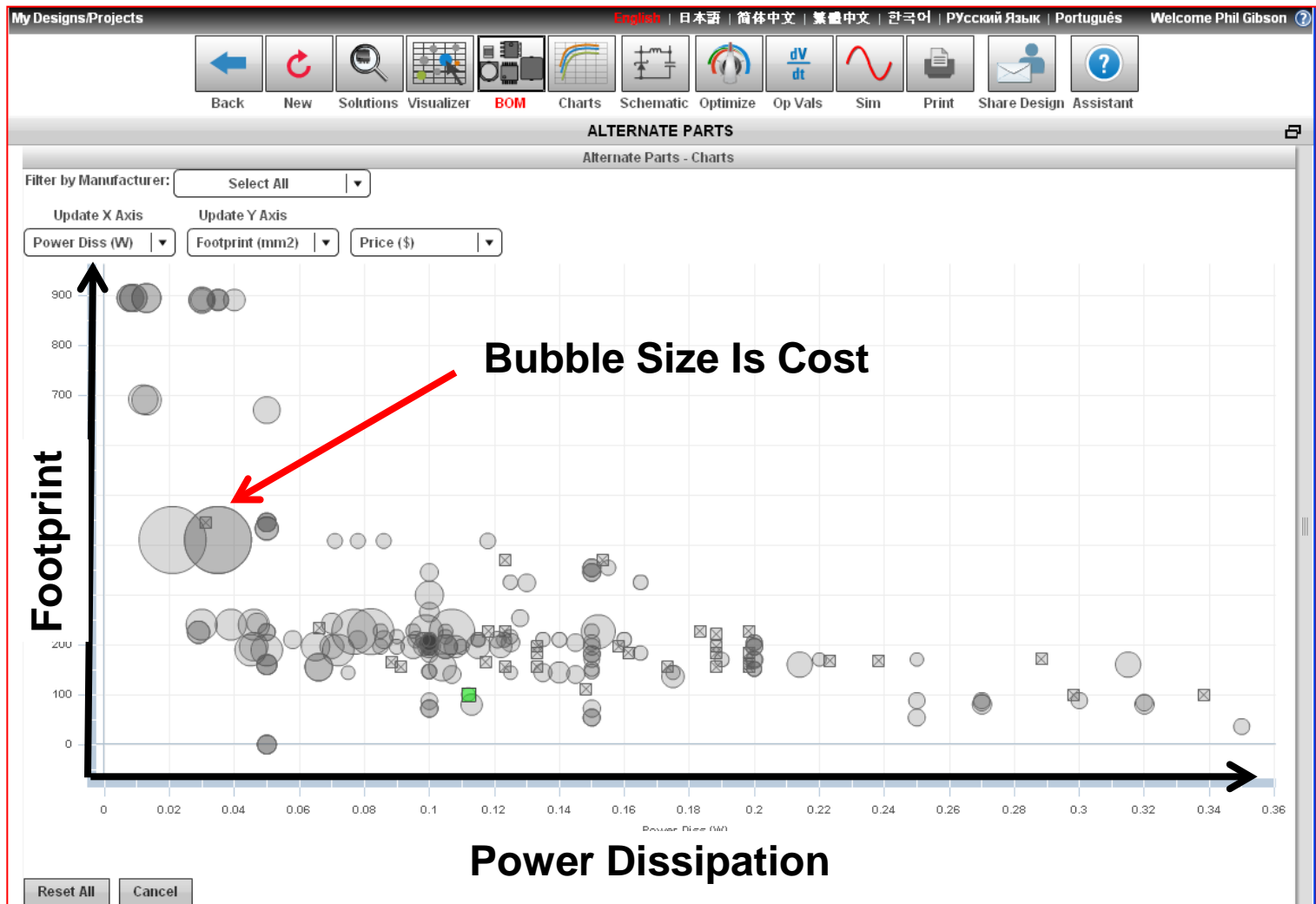
Parameter  
Specification  
Limits

Multiple  
Column Sort

Component  
Tradeoffs:  
Footprint  
Pdiss  
Price  
Performance  
Vout Ripple  
Transient Resp  
Loop Stability



# Evaluate Components – Inductor for each design in the project



# Select new component or Create a new component for your project

Filtered list based on zoom box

Click to select a component

Or create a custom component

My Designs/Projects

English | 日本語 | 简体中文 | 繁體中文 | 한국어 | Русский язык | Português | Welcome Phil Gibson

Back New Solutions Visualizer BOM Charts Schematic Optimize Op Vals Sin Print Share Design Assistant

### ALTERNATE PARTS

Alternate Parts - Charts

Filter by Manufacturer: Select All

Update X Axis: Power Diss (W) Update Y Axis: Footprint (mm2)

Footprint (mm2)

Power Diss (W)

Alternate parts displayed: 200

Reset All Cancel

Summary information for selected Component Summary information for selected Component L1:

Manuf	Part Number	L (H)	DCR (Ohm)	IDC (A)	Price	Qty Avail	Foot Print	Height	Power Diss	Top View
Bourns	SRU8043-6R8Y	6.8u	0.022	3.8	\$0.36	0	100	4.3	0.112	
LIMITS										
		L (H)	DCR (Ohm)		IDC (A)					
Upperbound		12.82u	0.083		68.57					
Lowerbound		6.409u	100u		3.429					
Target		6.409u	8.25m		3.429					

Select an alternate part for Component L1:

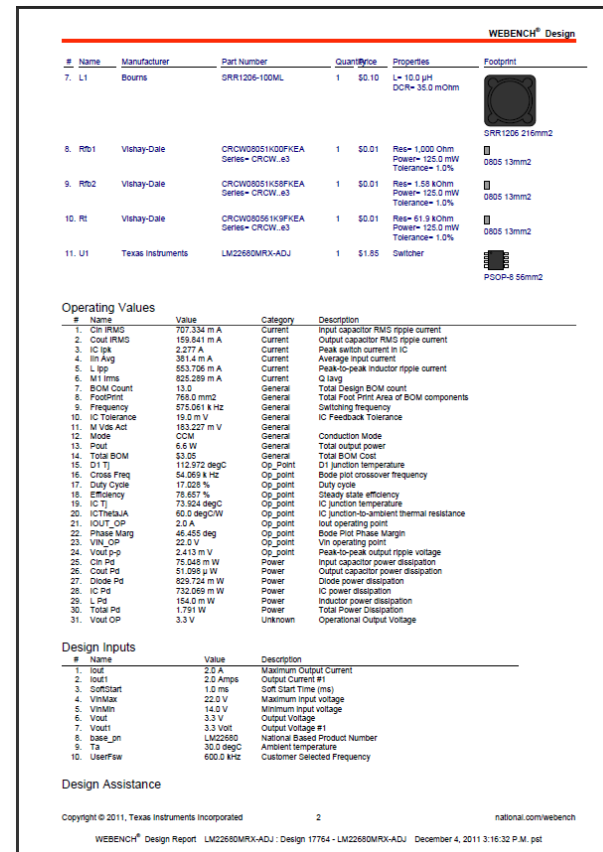
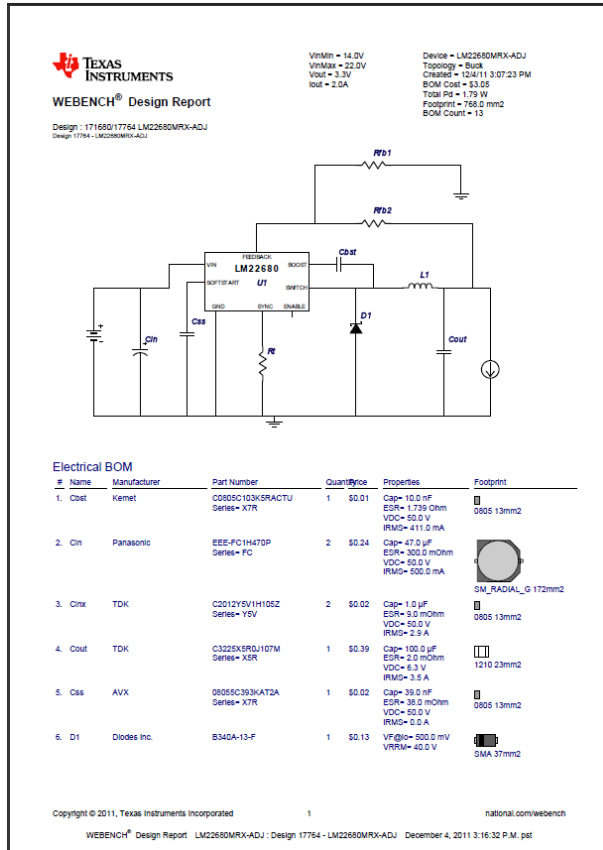
Edit	Manuf	Part Number	L (H)	DCR (Ohm)	IDC (A)	Price	Qty Avail	Foot Print	Height	Power Diss	Foot Print
Select	Bourns	SRU8043-6R8Y	6.8u	0.022	3.8	\$0.36	0	100	4.3	0.112	
Select	Pulse Engineering	P0751.103NLT	10u	0.05	3.8	\$0.33	> 10	170	5.46	0.250	
Select	Pulse Engineering	P0751.682NLT	6.8u	0.044	4.4	\$0.33	> 10	170	5.46	0.220	
Select	Bourns	SRU1038-100Y	10u	0.025	3.8	\$0.36	> 10	144	3.8	0.125	
Select	Bourns	SRU1048-8R2Y	8.2u	0.015	4.6	\$0.36	0	144	4.8	0.075	
Select	Collcraft	XAL4030-682ME	6.8u	0.07	3.6	\$0.60	> 10	36	3.1	0.350	
Select	Bourns	SRU1038-7R0Y	7u	0.035	4	\$0.40	0	144	3.8	0.175	
Select	PM3340-100MR	10u	0.033	3.5	\$0.46	> 10	183	11.5	0.165		

Create a Custom Part Cancel Reset All

NOTE: Limits Do Not Apply To Custom Parts

# Complete Power Supply Project Reporting: Automatic Generation

## Your Design From The Top: Inputs, Supplies, Schematics, BOMs

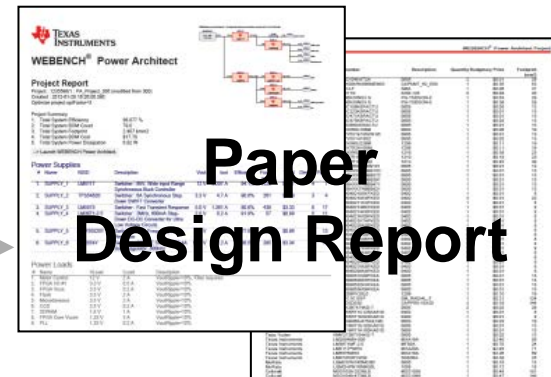
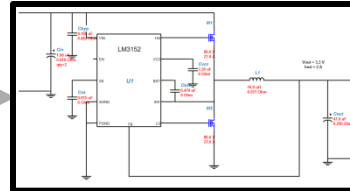


# WEBENCH® Schematic Export for Projects

- TI's WEBENCH power and LED lighting design tools are the industry's leading online tools to create and optimize analog designs.
- Before: Designers create a report in PDF summarizing the WEBENCH design and manually input the schematic into the CAD tool.
- Today: With WEBENCH Schematic Export, designers can export the schematic directly to five popular CAD formats.
- Advantages:
  - Saves time
  - Reduces errors
  - Allows use of optimized WEBENCH schematics

# Export WEBENCH® designs directly to CAD environment

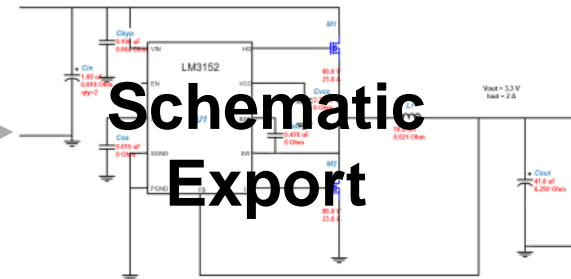
## Design Creation



## Paper Design Report

## Value inputs

- System design IP
- Component calculation
- Vendor selection
- Performance optimization
- Size optimization
- Relative pricing
- Speed/accuracy



## Schematic Export

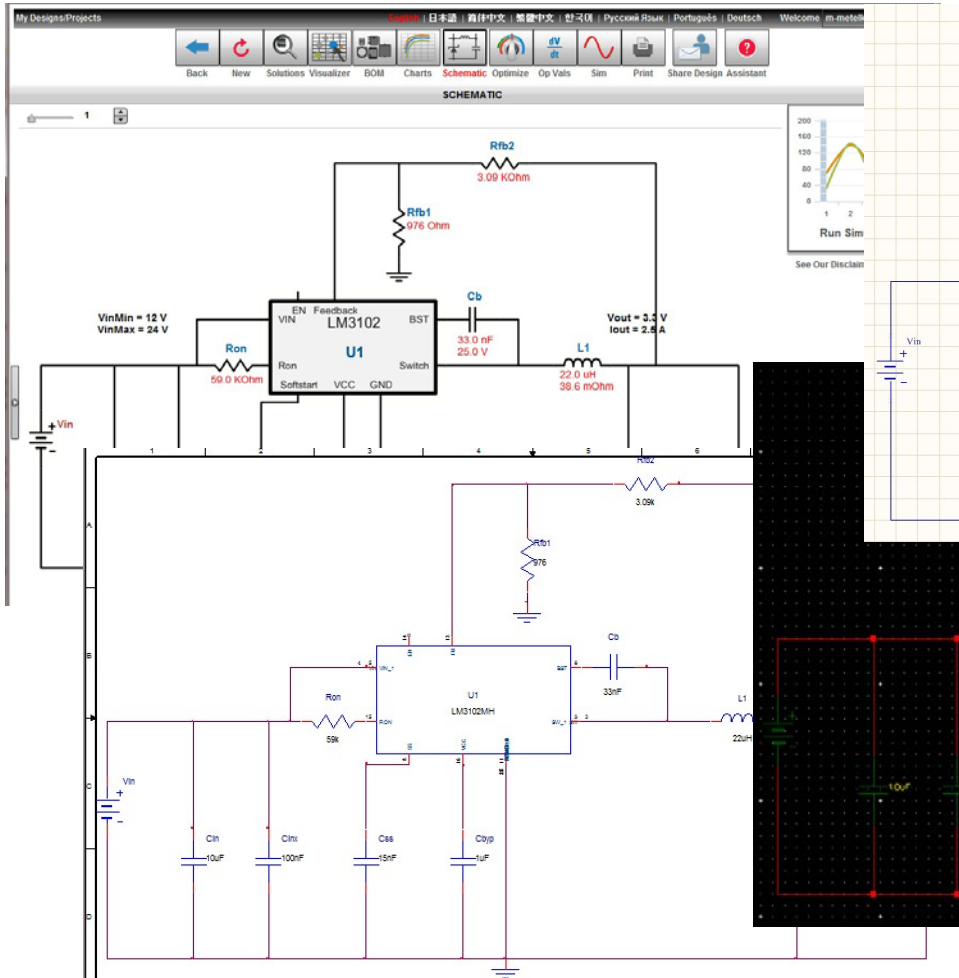
## Export directly into CAD formats



Altium Designer  
OrCAD Capture CIS  
DxDesigner  
DesignSpark  
P-CAD

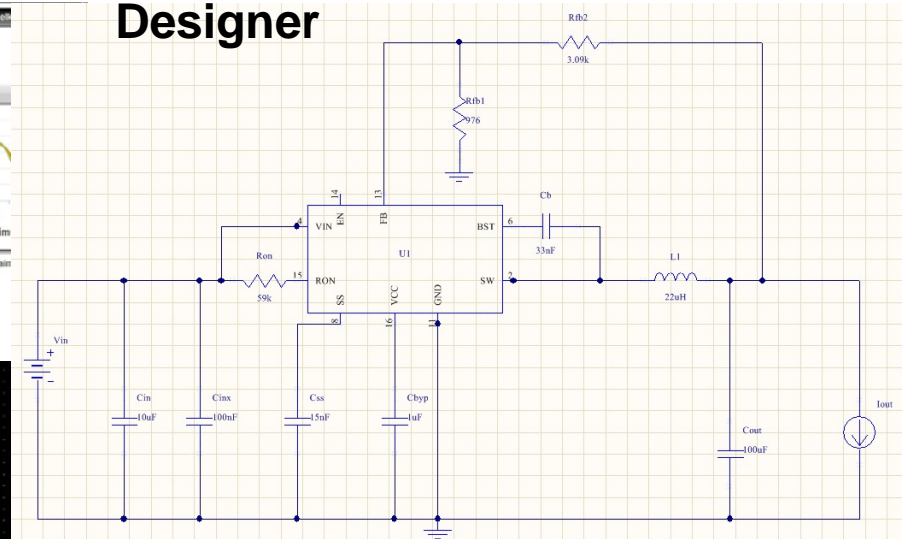
# WEBENCH® Export Directly to CAD Tool

## WEBENCH schematic



Exported schematic to Cadence OrCAD

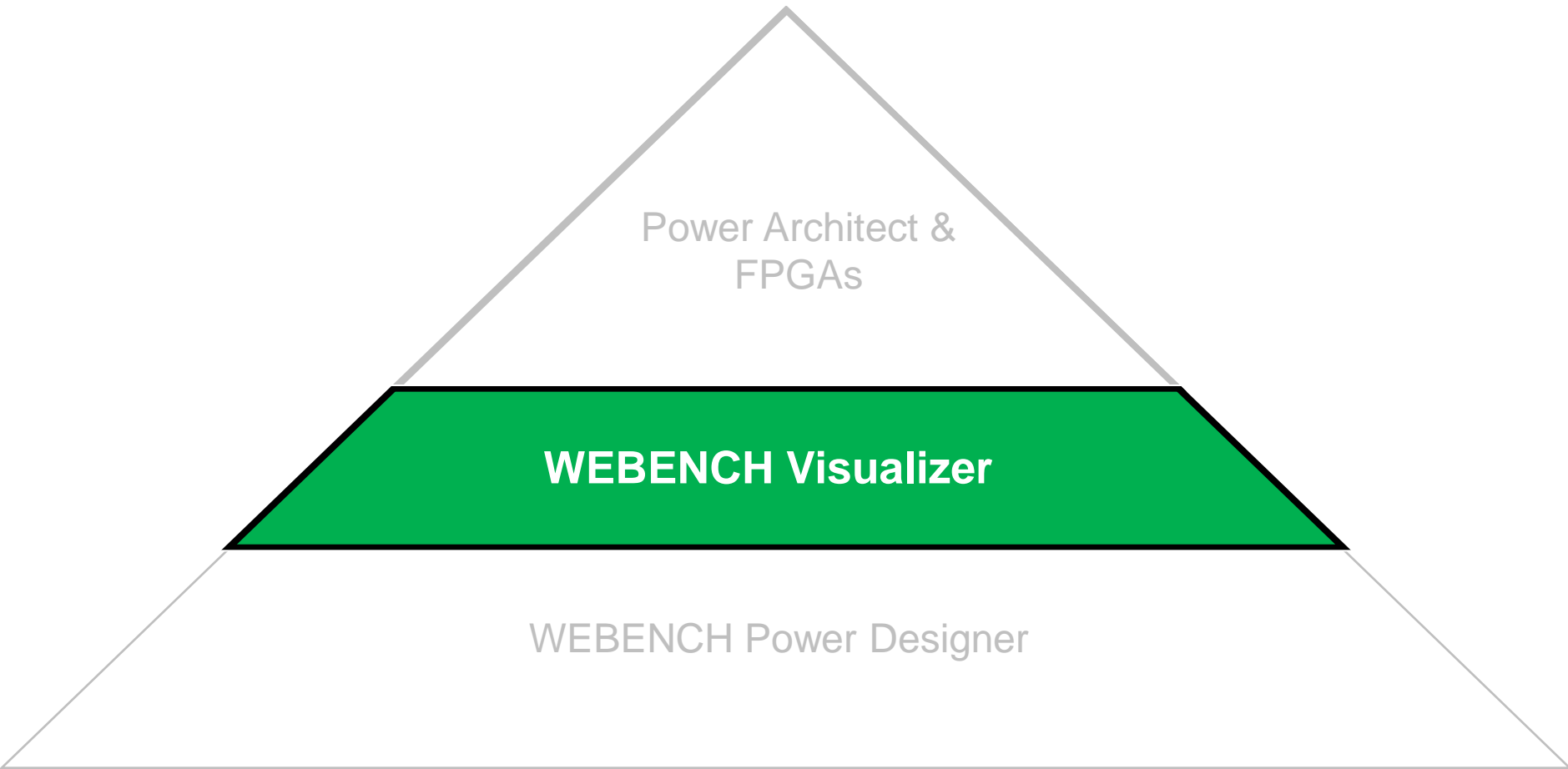
## Exported schematic to Altium Designer



Exported schematic to Mentor Graphics DxDesigner

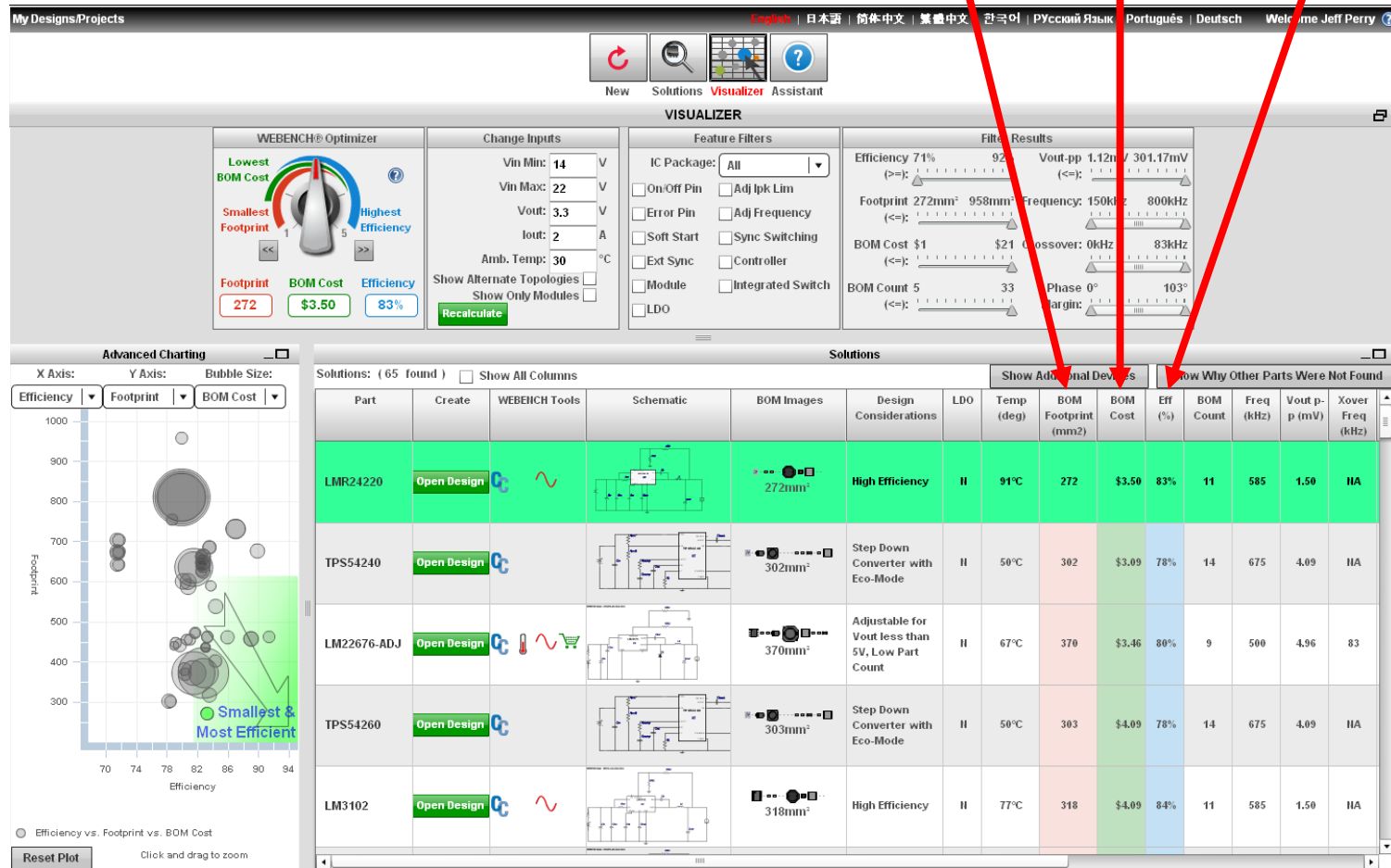
24

# The WEBENCH® Tool Suite

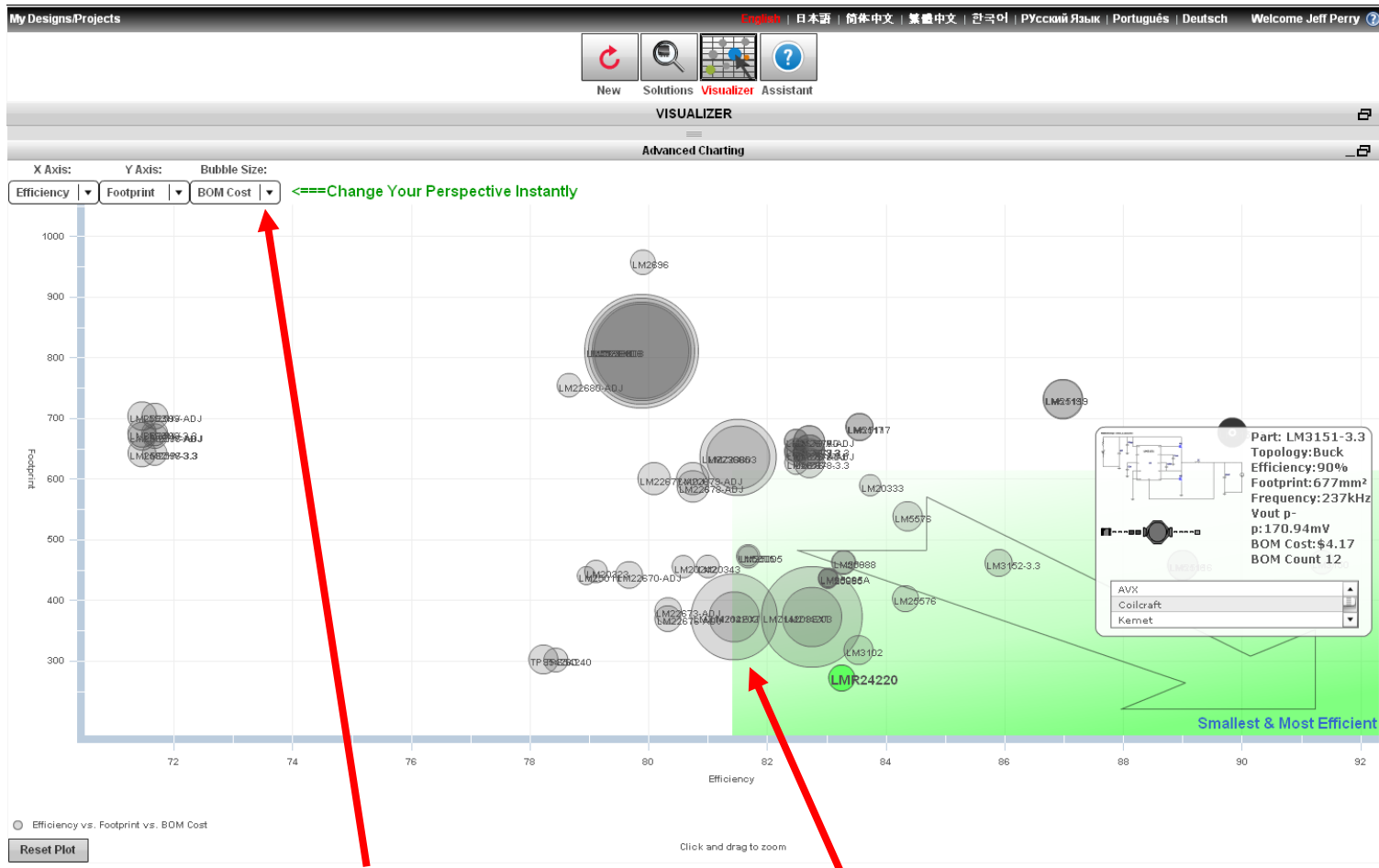


# Calculated BOM Footprint, BOM Cost and Efficiency

Footprint vs Cost vs Efficiency



# Graphical Plot Gives at a Glance Trade-offs



Click on square to resize the plot to full screen size

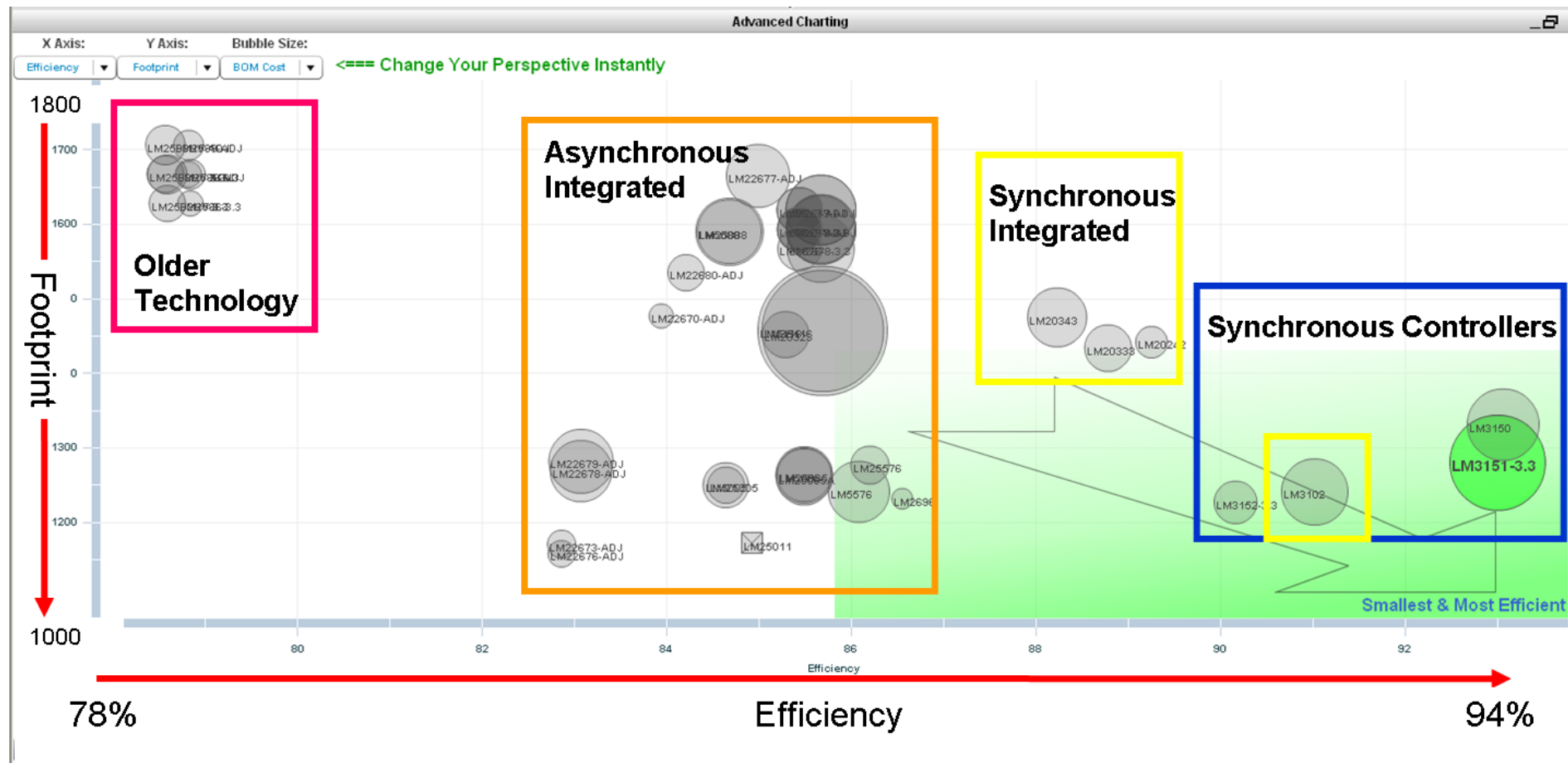
Hover to see details

Click and drag to zoom

Change plot parameters

Bubble Size = BOM Price

# Why Are the Solutions Different?



# Give The Engineers What They Want: Best Efficiency, Footprint and BOM Cost

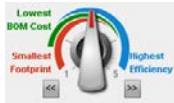
## Results from example:

Filter: Integrated Switch

Vin = 14V to 22V

Vout = 3.3V

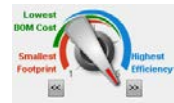
Iout = 2.0A



- Default Setting: LM25005, 83%, 416mm<sup>2</sup>, \$2.13



- **Smallest Footprint:** LMR24220, 78%, **218mm<sup>2</sup>**, \$2.47



- **Highest Efficiency:** LM26003, **91%**, 1357mm<sup>2</sup>, \$4.84

- Hint:

At each setting sort first for the most relevant parameter, then look for best compromise on the others

# The WEBENCH<sup>®</sup> Tool Suite

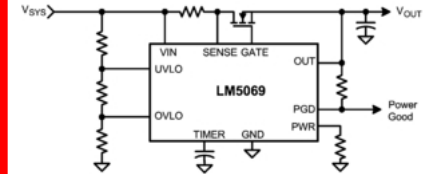
**Power Architect,  
FPGA Architect  
and Processor  
Architect**

WEBENCH Visualizer

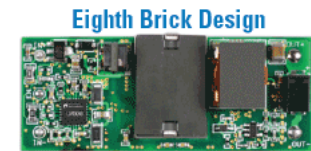
WEBENCH Power Designer

# What's New In WEBENCH® System Power Architect

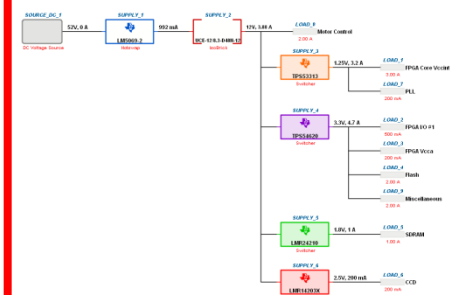
- Hot-swap protection with multiple TI component solutions



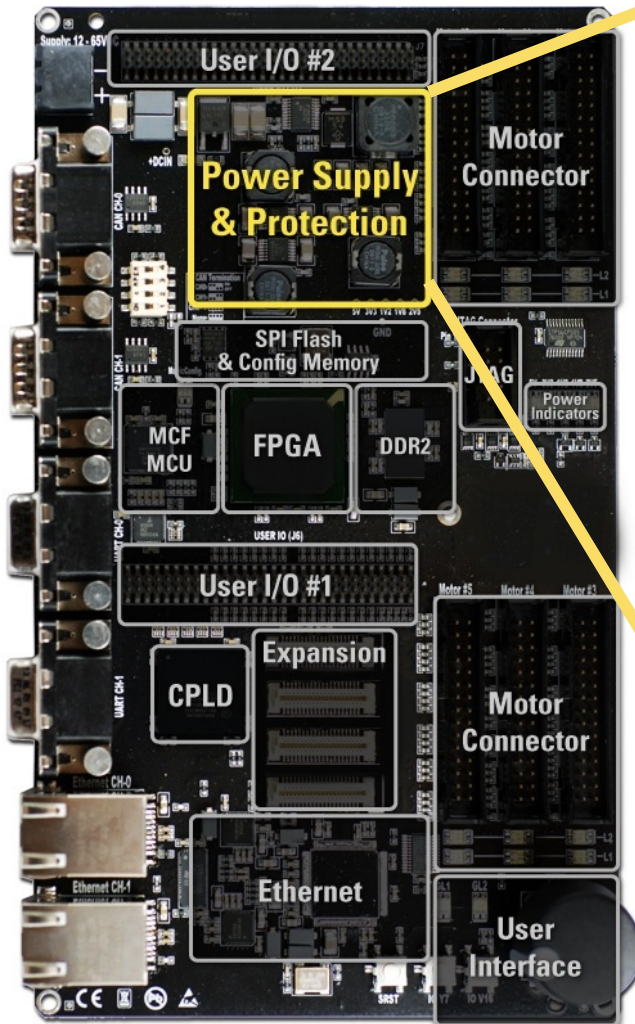
- Optimized selection of isolated modules



- Integration with all of the existing features of WEBENCH Power Architect
  - Optimize topologies for size, efficiency and cost
  - Buck, Boost, SEPIC, Buck-Boost, Inverting, Flyback, LDOs



# Design This Power Supply in Seconds?



## Many Loads, Many Supplies

- Core Supply 1.25V@3.0A
- FPGA IO 3.3V@0.5A
- Vcca 3.3V@0.2A
- Flash 3.3V@2.0A
- SDRAM 1.8V@1.0A
- CCD 2.5V@0.2A
- PLL 1.25@0.2A
- Motor Control 12V@2.0A
- Miscellaneous 3.3V@2.0A

9 Loads and 5 Voltages

# Why Have Reference Designs Been Needed For Complex FPGAs?

- **Cyclone IV GX - EP4CGX150**

- User guide: 463 pages, 10MB
- 20-30 pages of power details

- **Spartan-6 - XC6SLX100T**

- 40+ separate reference guides and datasheets: ~2000 pages, 90MB
- 15 pages critical for power details

- Each specification includes challenging requirements and exceptions
  - Voltage, current, ripple, frequency, accuracy, soft start, supply isolation, and pin specific limitations
- Every complete system has additional loads beyond the FPGA loads, adding more to the complexity

Minutes, right?  
With Confidence?

# WEBENCH® FPGA Power Architect

My Designs/Projects

English | 日本語 | 简体中文 | 繁體中文 | 한국어 | Русский язык | Português | Deutsch Welcome Jeff Perry ?

Back New FPGA/µP Add Loads Optimize View/Edit Power Supplies Assistant

FPGA/PROCESSOR POWER ARCHITECT

Configure FPGA Loads

Step # 1: Select your FPGA

Select Processors

Step #2: Add FPGA Supply Requirements

Selected FPGA: Altera Cyclone-IV GX EP4CGX50 FPGA Datasheet

IO Banks : 11  
Logic Elements : 49888  
PLLs : 8  
Total RAM : 2502  
User I/Os : 310  
Sequencing Requirement : No Sequencing control is Required.

Add FPGA

Select Loads to Add

Next Step : Add Loads ->

Part Number	Manufacturer	Series	NumLogic
EP4CGX50	Altera	Cyclone-IV GX	49,888.00
EP4CGX75	Altera	Cyclone-IV GX	73,920.00
EP4S100G2	Altera	Stratix-IV GT	228,000.00
EP4S100G3	Altera	Stratix-IV GT	291,200.00
EP4S100G4	Altera	Stratix-IV GT	353,600.00
EP4S100G5	Altera	Stratix-IV GT	531,200.00
EP4S40G2	Altera	Stratix-IV GT	228,000.00
EP4S40G5	Altera	Stratix-IV GT	531,200.00
EP4SE230	Altera	Stratix-IV E	228,000.00
EP4SE360	Altera	Stratix-IV E	353,600.00
EP4SE530	Altera	Stratix-IV E	531,200.00
EP4SE820	Altera	Stratix-IV E	813,050.00
EP4SGX110	Altera	Stratix-IV GX	105,600.00
EP4SGX180	Altera	Stratix-IV GX	175,750.00
EP4SGX230	Altera	Stratix-IV GX	228,000.00
EP4SGX290	Altera	Stratix-IV GX	291,200.00
EP4SGX360	Altera	Stratix-IV GX	353,600.00
EP4SGX530	Altera	Stratix-IV GX	531,200.00
EP4SGX70	Altera	Stratix-IV GX	72,600.00
ECP3-150	Lattice	ECP3	149,000.00
ECP3-17	Lattice	ECP3	17,000.00
ECP3-35	Lattice	ECP3	33,000.00
ECP3-70	Lattice	ECP3	67,000.00
ECP3-95	Lattice	ECP3	92,000.00
XC3S1400A	Xilinx	Spartan-3A	2,816.00
XC3S1400AN	Xilinx	Spartan-3AN	2,816.00

Load	Voltage	Current	Group
<input checked="" type="checkbox"/> VCCA	2.50 V	0.5 A	analog
<input checked="" type="checkbox"/> VCCA_GXB	2.50 V	0.1 A	bx2
<input checked="" type="checkbox"/> VCCD_PLL	1.20 V	0.5 A	digital1
<input checked="" type="checkbox"/> VCCD_GXB	2.50 V	0.5 A	bx2
<input checked="" type="checkbox"/> VCCINT	1.20 V	3 A	
<input checked="" type="checkbox"/> VCCIO#1	1.20 V	0.4 A	

Select Device From List

Configure Loads

# Get FPGA Load Current From Vendor Estimation Spreadsheet: Altera

Spreadsheet calculates the current

Altera to WEBENCH Spreadsheet3-wCyclone.xls [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Get Started Acrobat

Normal Page Layout Preview Custom Views Full Screen Workbook Views

Ruler Formula Bar Gridlines Headings Message Bar Show/Hide

Zoom 100% Zoom to Selection Zoom

New Window Arrange All Freeze Panes Hide Unhide Split View Side by Side Synchronous Scrolling Reset Window Position Save Switch Workspace Windows

D12

1 **ALTERA** Visit the Online Power Management Resource Center PowerPlay Early Power Estimator Cyclone® III, Cyclone® III LS, Cyclone® IV V9.1 B21 Release Notes

2

3

4 Comments:

5 **Input Parameters**

6 Family Cyclone IV GX

7 Device EP4CGX15B

8 Package F14 (F169)

9 Temperature Grade Commercial

10 Power Characteristics Typical

11 V<sub>CCINT</sub> Voltage (V) 1.200

12

13 ☐ User Entered T<sub>j</sub> ☒ Auto Computed T<sub>j</sub>

14 Ambient Temp, T<sub>A</sub> (°C) 25

15 ☐ Custom Theta JA ☒ Estimated Theta JA

16 Heat Sink 23 mm - Medium Profile

17 Airflow Still Air

18

19 **Thermal Power (W)**

20 Logic 0.835

21 RAM 0.090

22 DSP 0.214

23 I/O 0.113

24 PLL 0.081

25 Clock 0.116

26 XCVR 0.305

27 PCS and HIP 0.381

28 P<sub>static</sub> 0.164

29 **TOTAL** 2.299

30

31 **Thermal Analysis**

32 Junction Temp, T<sub>j</sub> (°C) 56.7

33 θ<sub>JA</sub> Junction-Ambient 13.81

34 Maximum Allowed T<sub>A</sub>(°C) 53

35 **Details**

36

37 **Power Supply Current (A)**

38 I<sub>CCINT</sub> (1.20V) 1.362

39 I<sub>CCA</sub> (2.50V) 0.042

40 I<sub>CCP</sub> (1.20V) 0.088

41 **ICCIO** 0.042

42 I<sub>CCA\_GXB</sub> (2.50V) 0.008

43 I<sub>CCU\_GXB</sub> (2.50V) 0.049

44

45 Power Main Logic RAM DSP IO PLL Clock XCVR Report Version

Ready

# Get FPGA Load Current From Vendor Estimation Spreadsheet: Xilinx

Spreadsheet calculates the current

**XILINX®** XPower Estimator (XPE) - 12.2  
Extended Spartan®-3A, Spartan®-6  
Release: 21-Jul-2010

Export... Import... Reset to Defaults Set Default Activity Rates...

**Project**

**Settings**

Device	
Family	Spartan-6
Part	XC6SLX150
Package	CSG484
Speed Grade	-2
Grade	Commercial
Process	Typical
Power Mode	Active
Characterization	Advance 21-Jul-2010

**Environment**

Junction Temperature	<input type="checkbox"/> User Override
Ambient Temp	25.0 °C

**On-Chip Power**

Resource	Power (W)	Power (%)
CLOCK	0.016	0
Logic	3.189	91
BRAM	0.000	0
DSP	0.000	0
DCM	0.000	0
PLL	0.000	0
MCB	0.000	0
I/O	0.000	0
Transceiver		
Device Static	0.303	9

**Power Supply**

Source	Voltage (V)	Total (A)
VCCINT	1.200	2.875
VCCAUX	2.500	0.023
VCCO 3.3	3.300	0.000
VCCO 2.5	2.500	0.000
VCCO 1.8	1.800	0.000
VCCO 1.5	1.500	0.000
VCCO 1.2	1.200	0.000
-		
-		
-		
-		

Summary CLOCK LOGIC IO BRAM DSP DCM PLL MCB User Graphs Release

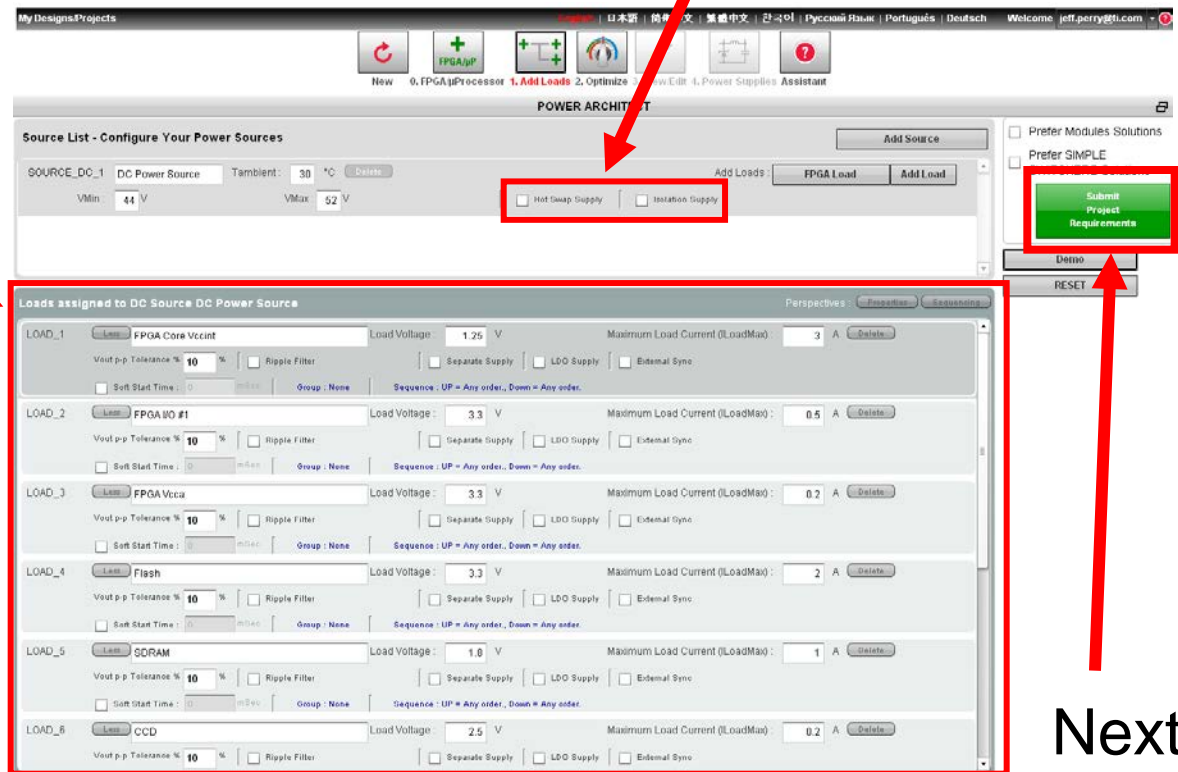
# Update Load Current Into Preconfigured FPGA Loads Template

Voltage, Current,  
and Special  
Requirements  
Included For:

- Max Voltage Ripple
- Isolated Supplies
- Soft Start
- Post Supply Filters
- LDO Preferred

Add All Of Your Own  
Additional System  
Loads

Hot-swap and  
Isolated Modules



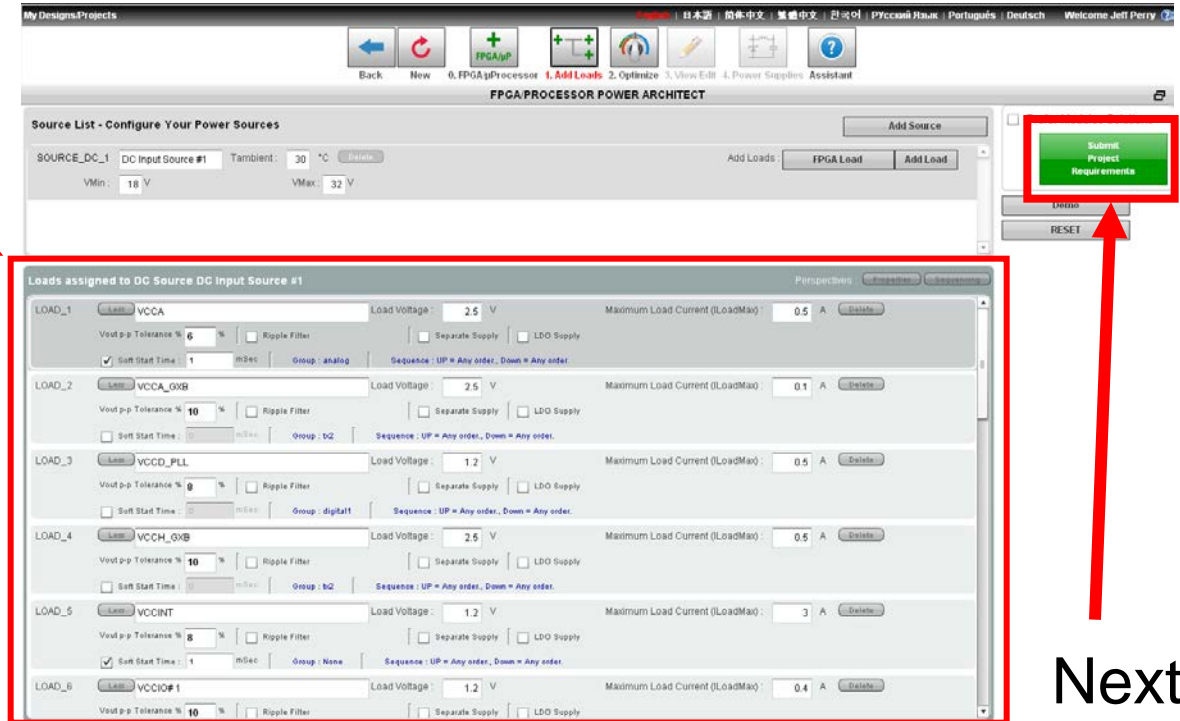
Next

# Enter Additional Loads

Voltage, Current,  
and Special  
Requirements  
Included For:

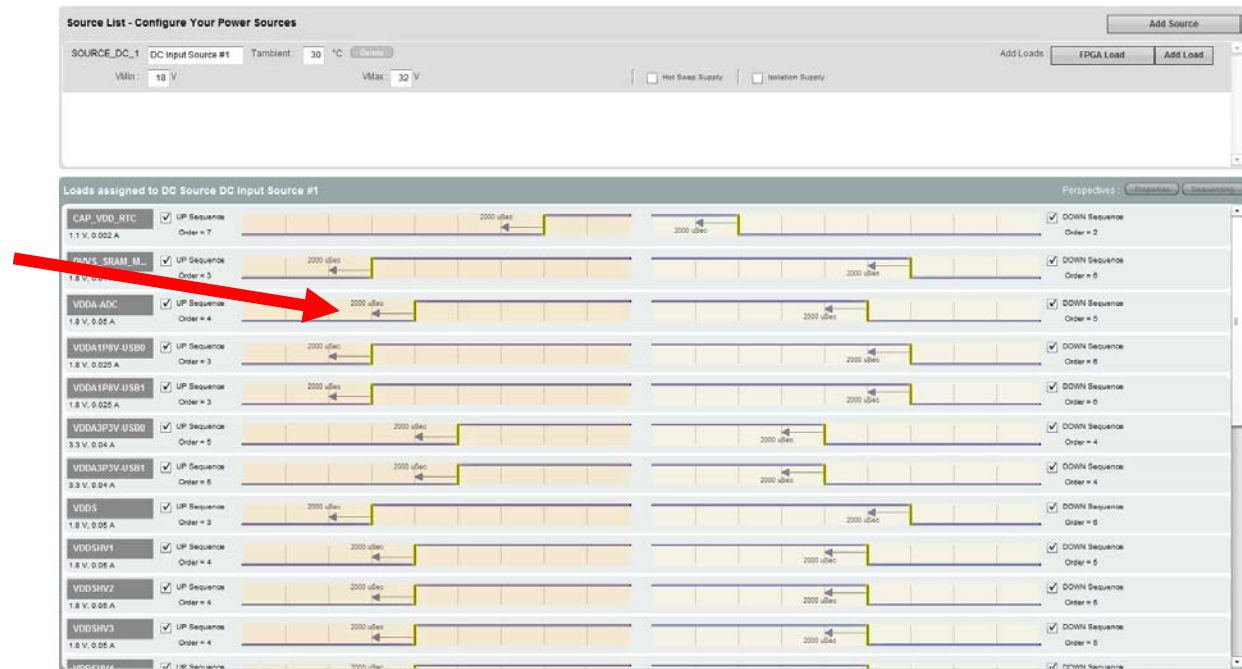
- Max Voltage Ripple
- Isolated Supplies
- Soft Start
- Post Supply Filters
- LDO Preferred

Add All Of Your Own  
Additional System  
Loads



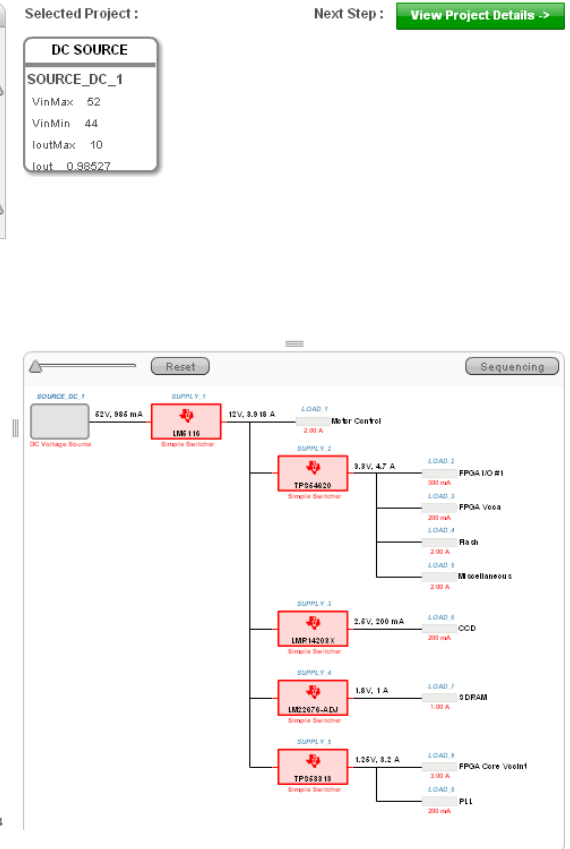
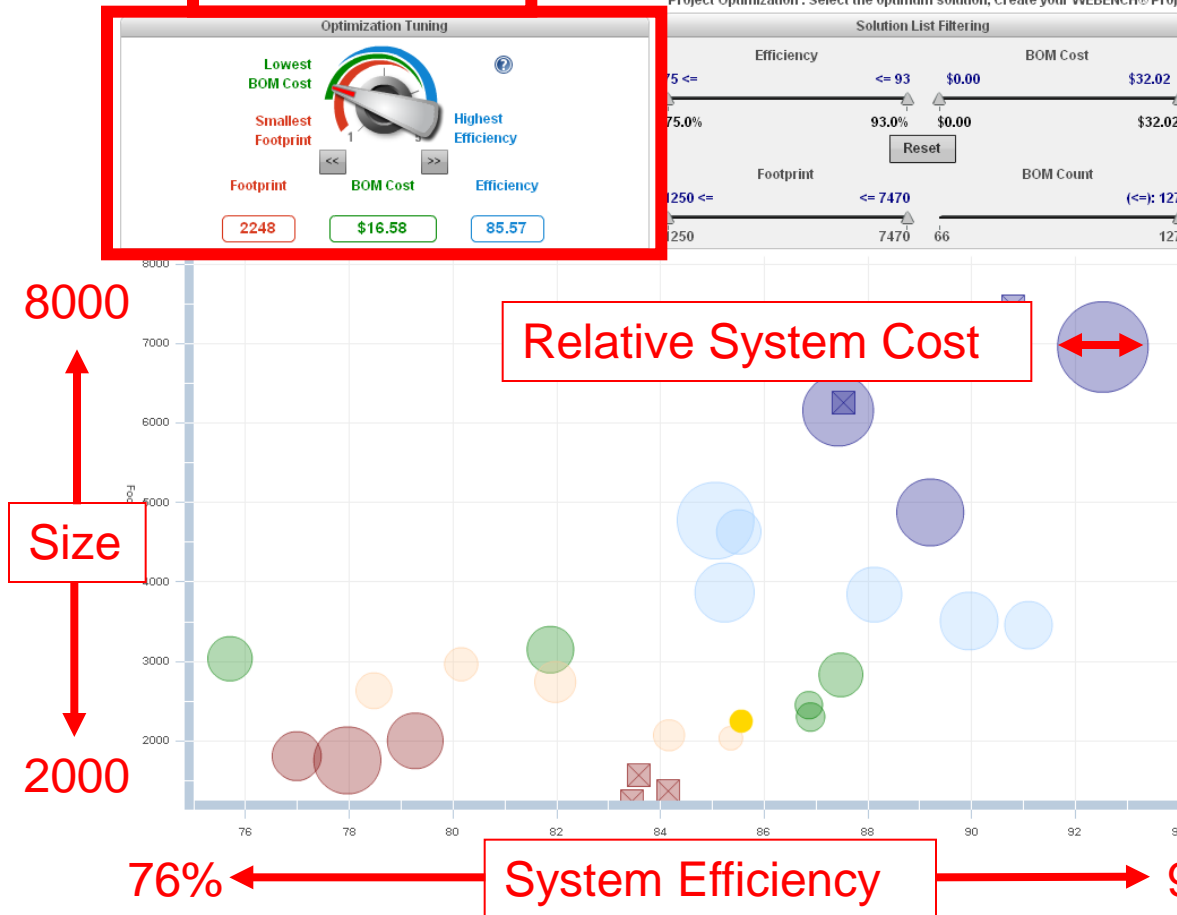
# Sequencing Requirements

- Sequencing requirements of the selected FPGA/uP captured
- Modify sequencing based on system requirement
- Devices with Enable pin are selected to meet sequencing requirements

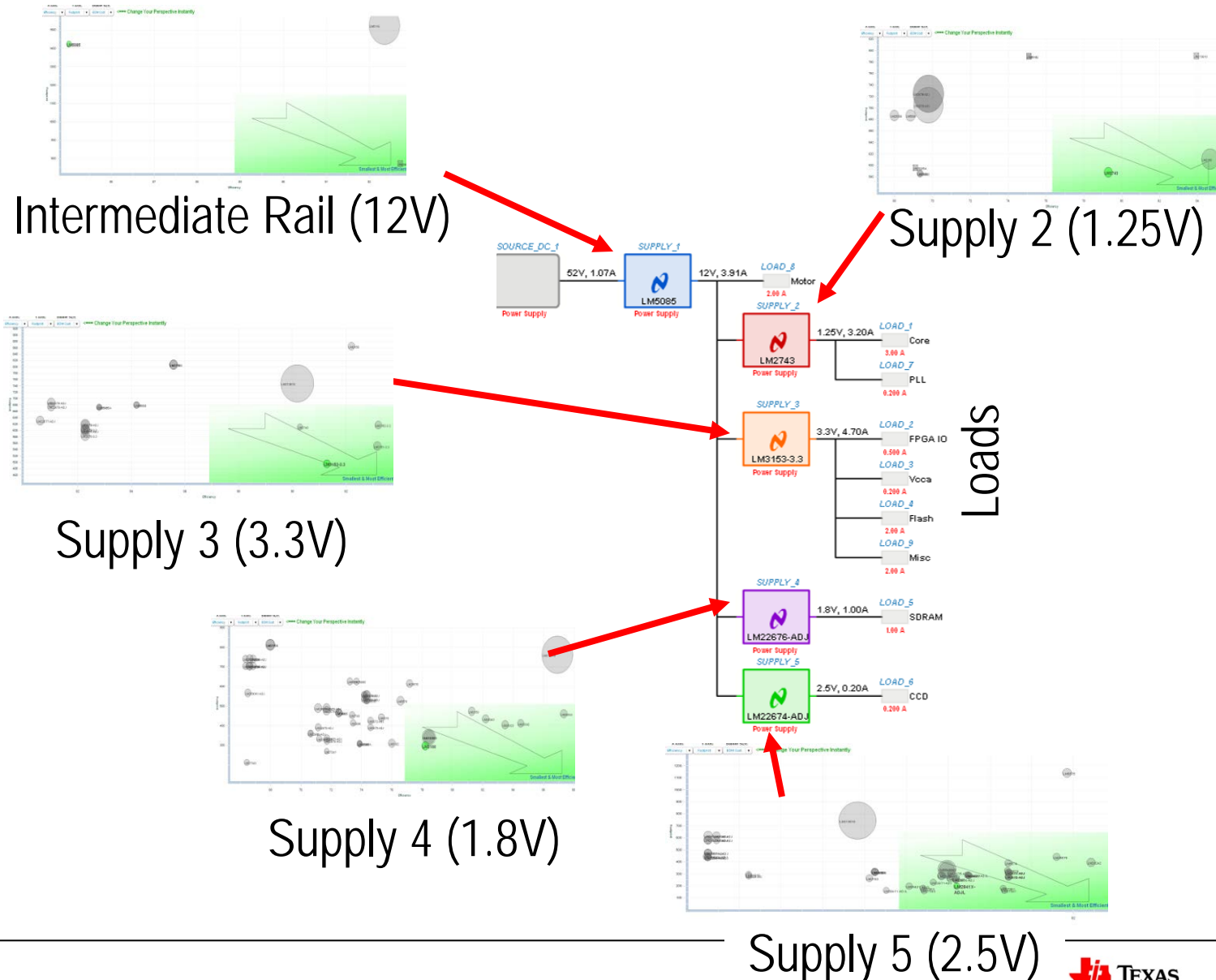


- Rails with same output voltage but different sequencing requirements are separated to satisfy sequencing requirements

# Each Architecture Is Tuned With The WEBENCH® Optimizer, Now For Systems

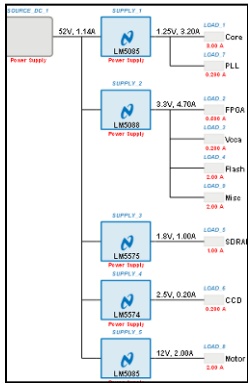


# WEBENCH® FPGA Power Architect Selects The Best Solutions For Every Rail



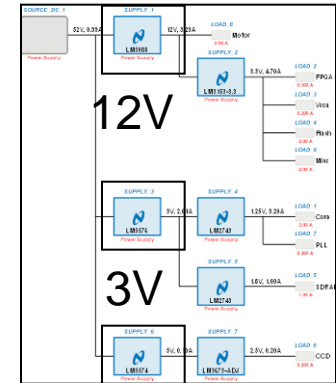
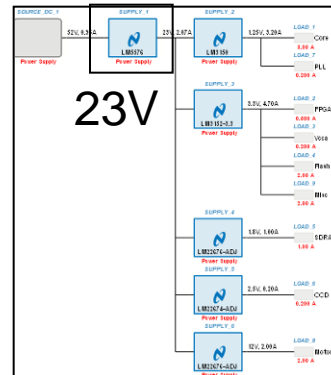
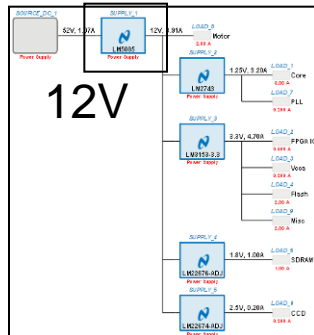
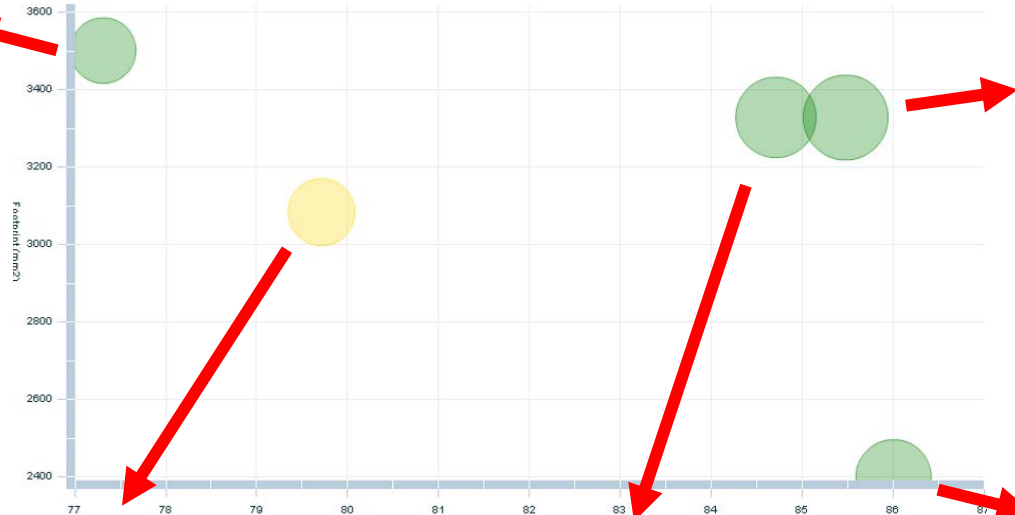
# Presenting The User With The Intermediate Rail Options And Performance Trade-Offs

Intermediate Rail Options Can Be Reviewed & Compared Quickly



No I-Rail

Lowest Cost



Smallest Footprint  
Highest Efficiency

# Analyze Performance, Cost and Footprint for Selected Architecture

My Designs/Projects

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Back New FPGA/μP Add Loads Optimize 3. View/Edit 4. Power Supplies Print Project Share Project Assistant

FPGA/PROCESSOR POWER ARCHITECT

PA\_Project\_206 (modified from 201) Rename \$16.58 85.6% 2,248 mm2 View Edit Compare

Next Step: Cancel Changes Save Changes **Create Project**

Project Charts Summary

Click on Each Supply To Display Detail

**SUPPLY\_1** LM5116 Simple Switcher

DC Voltage source 52V, 985 m

2V, 3.918 A LOAD\_1 Motor Control 2.00 A

3.3V, 4.7 A LOAD\_2 FPGA I/O #1 500 mA

200 mA LOAD\_3 FPGA Vcca 200 mA

2.00 A LOAD\_4 Flash 2.00 A

2.00 A LOAD\_5 Miscellaneous 2.00 A

2.5V, 200 mA LOAD\_6 CCD 200 mA

1.8V, 1 A LOAD\_7 SDRAM 1.00 A

1.25V, 3.2 A LOAD\_8 FPGA Core Vccint 3.00 A

200 mA LOAD\_9 PLL 200 mA

Power Dissipation (Watts) BOM Cost (\$) Footprint (mm2)

**SUPPLY\_1 LM5116 100V Synchronous Buck Controller**

Regulator Design Load List

VinMin: 44.0 V VinMax: 52.0 V

Vout: 12 Update

Iout Max: 20.0 Iout (calculated): 3.9183

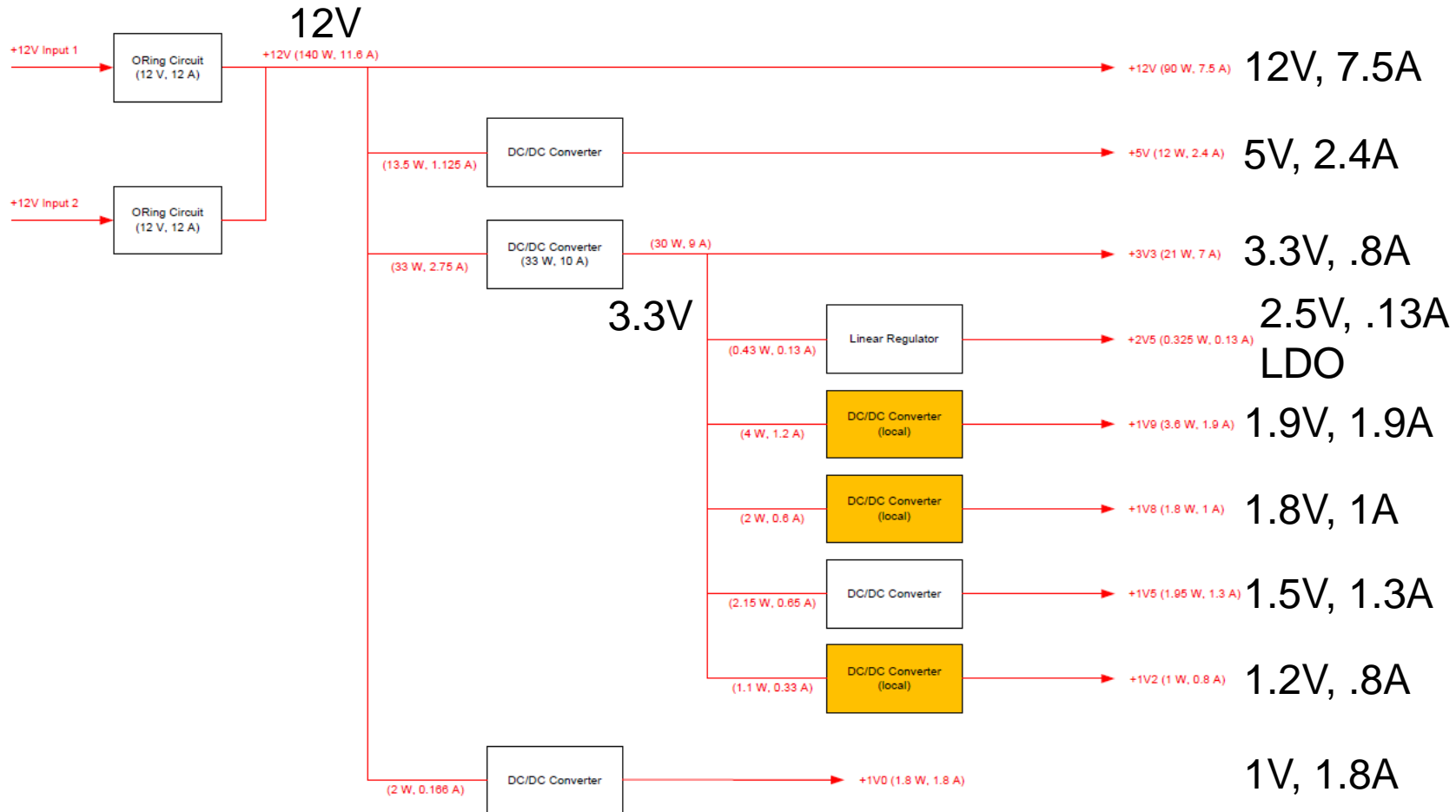
Recommended Solution: LM5116

Select Alternate Regulator	Effic ienc	Foot prin.	BOM Cost \$
LM5116MH	0.918	1,165	\$5.11

43 Delete this Supply Move this Supply to

# What if this is your desired power tree?

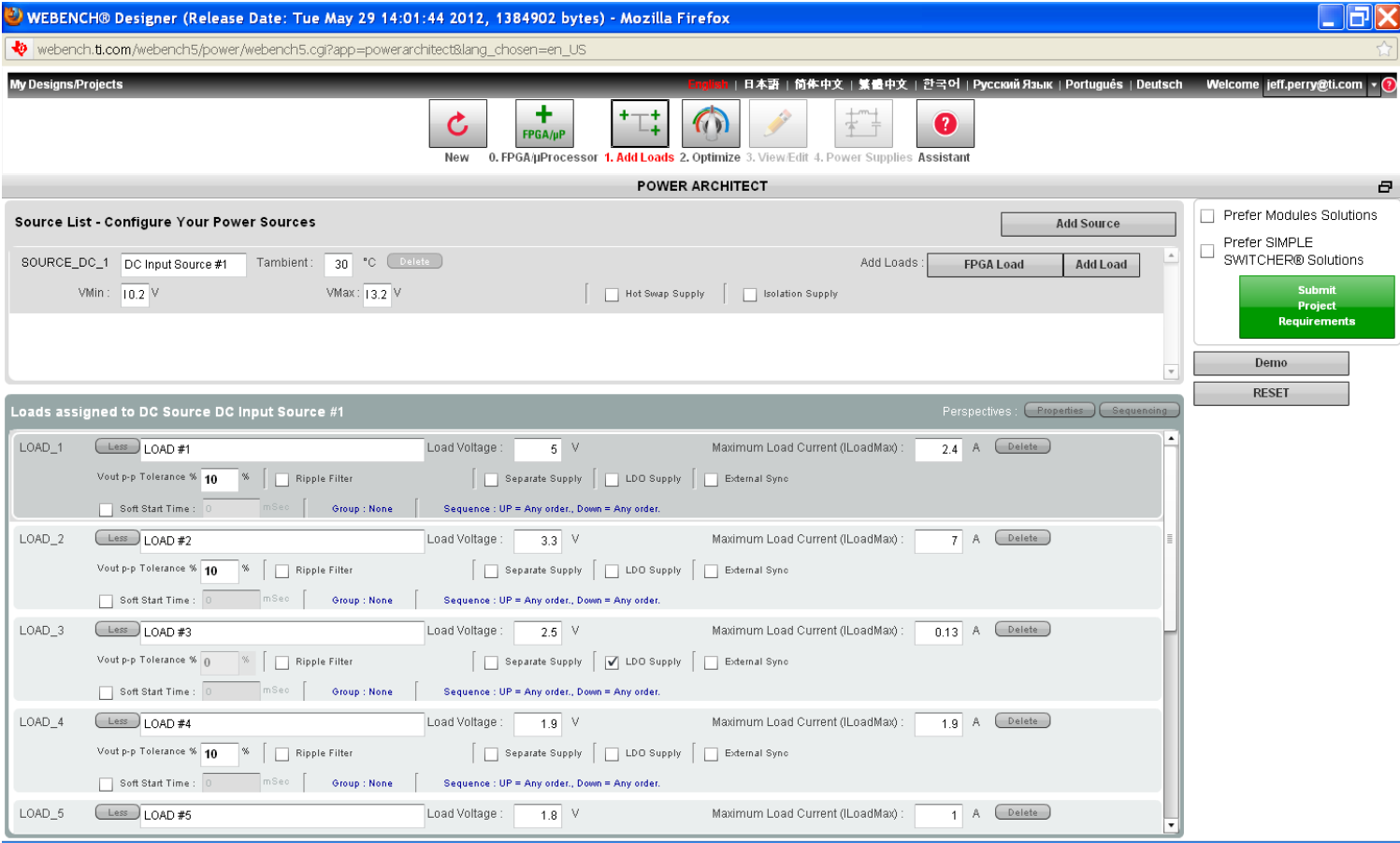
## How to edit your Power Architect design



# Enter loads

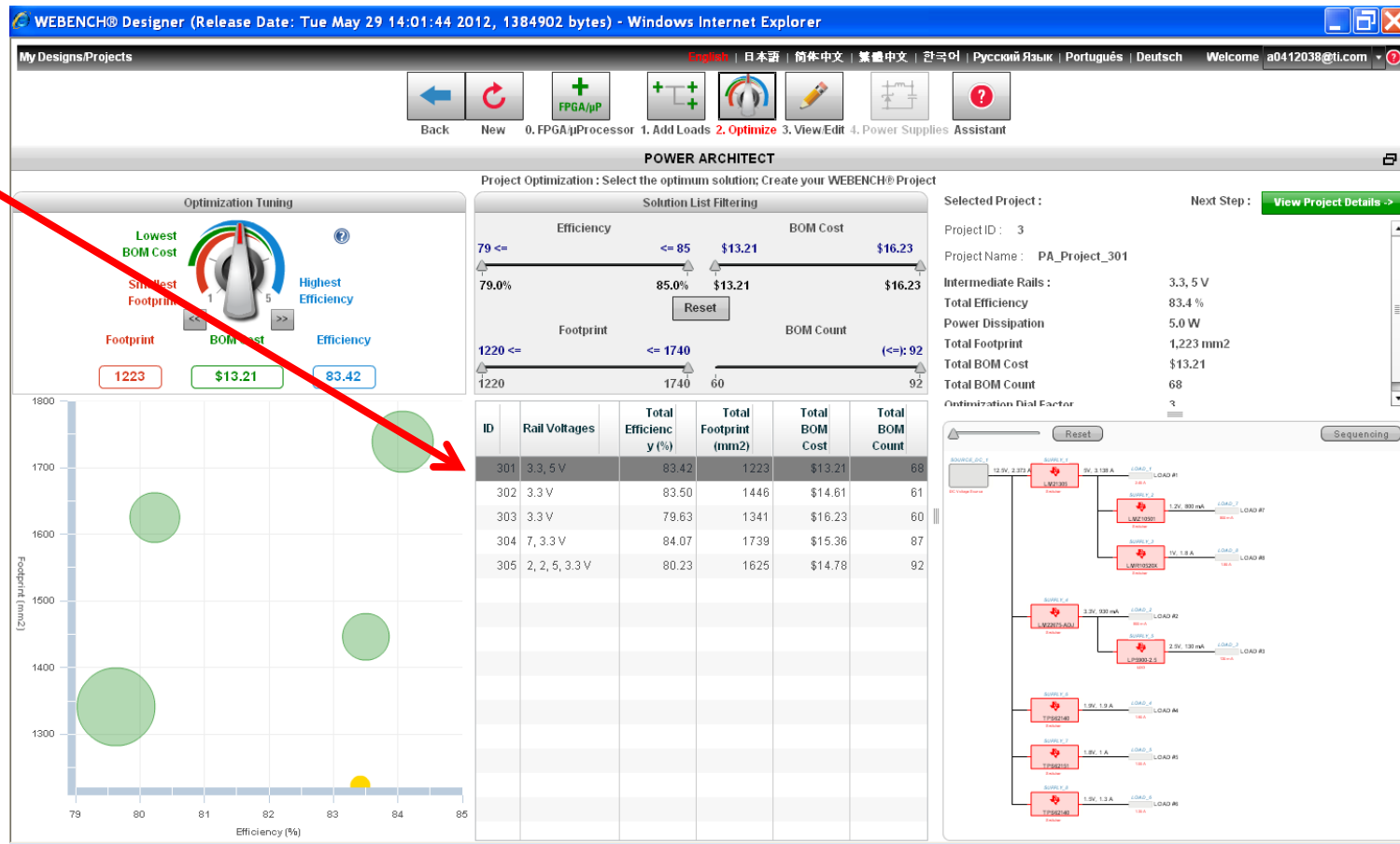
Enter all loads except for the unregulated 12V, 7.5A load.

Only used 1 input source.



# Select Architecture

Architecture 301 has 5V and 3.3V intermediate rails.  
This is close to what is in the spec.



# Edit the block diagram

Click on the Edit button

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webench.ti.com/webench5/power/webench5.cgi?app=powerarchitect&lang\_chosen=en\_US

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Back New FPGA/µP Add Loads 2. Optimize 3. View/Edit 4. Power Supplies Assistant

POWER ARCHITECT

PA\_Project\_306 (modified from 302) Rename \$15.92 89.1% 1,608 mm2 View Edit Compare Next Step: Cancel Changes Save Changes Create Project

Reset Add Source Edit Sequence

DC Voltage Source

SUPPLY\_1 10.2V, 3.84A LMC1305

EV, 3.092 A LOAD\_1

SUPPLY\_2 1.2V, 800 mA LMC1050-1

TV, 1.8 A LOAD\_3 TLV62180

SUPPLY\_3 3.3V, 7.19 A LOAD\_2 LMC743

2.4V, 180 mA LOAD\_3 LPS6000-2.6

SUPPLY\_4 1.8V, 1.8 A LOAD\_4 TLV62180

1.8V, 1 A LOAD\_5 LMP54210

1.8V, 1.8 A LOAD\_6 LMC6475

Project Charts Summary

Power Dissipation (Watts)

BOM Cost (\$)

Footprint (mm2)

SUPPLY\_1 LM21305 High Frequency Synchronous Buck Regulator

Regulator Design Load List

VinMin: 10.2 V VinMax: 13.2 V

Vout: 5 Update

Iout (calculated): 3.0318 Iout Max: 5

Recommended Solution: LM21305

Select Alternate Regulator

Regulator	Efficien...	Footprint mm2	BOM Cost \$
LM21305SQ	0.926	322	\$3.10
TPS54620RHLLR	0.946	250	\$3.75
TPS54622RHLLR	0.946	250	\$3.75
TPS54623RHLLR	0.946	250	\$3.80
LM2743MTC	0.948	360	\$2.48
TPS53313RGER	0.953	429	\$3.81

Delete this Supply Move this Supply to

# Move Supplies

2) Click on the "Move" drop down to specify move to supply 4

1) Click on the supply that you want to move

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webench.ti.com/webench5/power/webench5.cgi?app=powerarchitect&lang\_chosen=en\_US

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Back New 0. FPGA/jpP Add Loads 2. Optimize 3. View/Edit 4. Power Supplies Assistant

POWER ARCHITECT

PA\_Project\_306 (modified from 302) Rename \$15.92 89.1% 1,608 mm2 View Edit Compare Next Step: Cancel Changes Save Changes Create Project

Reset Add Source Edit Sequence

SOURCE DC 1 19.2V, 8.84A SUPPLY\_1 LMC1105 5V, 3.032 A LOAD 1 LOAD #1

SUPPLY\_2 L2V, 800 mA LOAD 7

SUPPLY\_3 TV, 1.8 A LOAD 4

SUPPLY\_4 L2V, 130 mA LOAD 3

SUPPLY\_5 LRV, 1.8 A LOAD 4

SUPPLY\_6 LRV, 1 A LOAD 5

SUPPLY\_7 LRV, 1.8 A LOAD 6

SUPPLY\_8 LRV, 1.8 A LOAD 6

SUPPLY\_9 LRV, 1.8 A LOAD 6

SUPPLY\_10 LRV, 1.8 A LOAD 6

SUPPLY\_11 LRV, 1.8 A LOAD 6

SUPPLY\_12 LRV, 1.8 A LOAD 6

SUPPLY\_13 LRV, 1.8 A LOAD 6

SUPPLY\_14 LRV, 1.8 A LOAD 6

SUPPLY\_15 LRV, 1.8 A LOAD 6

SUPPLY\_16 LRV, 1.8 A LOAD 6

SUPPLY\_17 LRV, 1.8 A LOAD 6

SUPPLY\_18 LRV, 1.8 A LOAD 6

SUPPLY\_19 LRV, 1.8 A LOAD 6

SUPPLY\_20 LRV, 1.8 A LOAD 6

SUPPLY\_21 LRV, 1.8 A LOAD 6

SUPPLY\_22 LRV, 1.8 A LOAD 6

SUPPLY\_23 LRV, 1.8 A LOAD 6

SUPPLY\_24 LRV, 1.8 A LOAD 6

SUPPLY\_25 LRV, 1.8 A LOAD 6

SUPPLY\_26 LRV, 1.8 A LOAD 6

SUPPLY\_27 LRV, 1.8 A LOAD 6

SUPPLY\_28 LRV, 1.8 A LOAD 6

SUPPLY\_29 LRV, 1.8 A LOAD 6

SUPPLY\_30 LRV, 1.8 A LOAD 6

SUPPLY\_31 LRV, 1.8 A LOAD 6

SUPPLY\_32 LRV, 1.8 A LOAD 6

SUPPLY\_33 LRV, 1.8 A LOAD 6

SUPPLY\_34 LRV, 1.8 A LOAD 6

SUPPLY\_35 LRV, 1.8 A LOAD 6

SUPPLY\_36 LRV, 1.8 A LOAD 6

SUPPLY\_37 LRV, 1.8 A LOAD 6

SUPPLY\_38 LRV, 1.8 A LOAD 6

SUPPLY\_39 LRV, 1.8 A LOAD 6

SUPPLY\_40 LRV, 1.8 A LOAD 6

SUPPLY\_41 LRV, 1.8 A LOAD 6

SUPPLY\_42 LRV, 1.8 A LOAD 6

SUPPLY\_43 LRV, 1.8 A LOAD 6

SUPPLY\_44 LRV, 1.8 A LOAD 6

SUPPLY\_45 LRV, 1.8 A LOAD 6

SUPPLY\_46 LRV, 1.8 A LOAD 6

SUPPLY\_47 LRV, 1.8 A LOAD 6

SUPPLY\_48 LRV, 1.8 A LOAD 6

SUPPLY\_49 LRV, 1.8 A LOAD 6

SUPPLY\_50 LRV, 1.8 A LOAD 6

SUPPLY\_51 LRV, 1.8 A LOAD 6

SUPPLY\_52 LRV, 1.8 A LOAD 6

SUPPLY\_53 LRV, 1.8 A LOAD 6

SUPPLY\_54 LRV, 1.8 A LOAD 6

SUPPLY\_55 LRV, 1.8 A LOAD 6

SUPPLY\_56 LRV, 1.8 A LOAD 6

SUPPLY\_57 LRV, 1.8 A LOAD 6

SUPPLY\_58 LRV, 1.8 A LOAD 6

SUPPLY\_59 LRV, 1.8 A LOAD 6

SUPPLY\_60 LRV, 1.8 A LOAD 6

SUPPLY\_61 LRV, 1.8 A LOAD 6

SUPPLY\_62 LRV, 1.8 A LOAD 6

SUPPLY\_63 LRV, 1.8 A LOAD 6

SUPPLY\_64 LRV, 1.8 A LOAD 6

SUPPLY\_65 LRV, 1.8 A LOAD 6

SUPPLY\_66 LRV, 1.8 A LOAD 6

SUPPLY\_67 LRV, 1.8 A LOAD 6

SUPPLY\_68 LRV, 1.8 A LOAD 6

SUPPLY\_69 LRV, 1.8 A LOAD 6

SUPPLY\_70 LRV, 1.8 A LOAD 6

SUPPLY\_71 LRV, 1.8 A LOAD 6

SUPPLY\_72 LRV, 1.8 A LOAD 6

SUPPLY\_73 LRV, 1.8 A LOAD 6

SUPPLY\_74 LRV, 1.8 A LOAD 6

SUPPLY\_75 LRV, 1.8 A LOAD 6

SUPPLY\_76 LRV, 1.8 A LOAD 6

SUPPLY\_77 LRV, 1.8 A LOAD 6

SUPPLY\_78 LRV, 1.8 A LOAD 6

SUPPLY\_79 LRV, 1.8 A LOAD 6

SUPPLY\_80 LRV, 1.8 A LOAD 6

SUPPLY\_81 LRV, 1.8 A LOAD 6

SUPPLY\_82 LRV, 1.8 A LOAD 6

SUPPLY\_83 LRV, 1.8 A LOAD 6

SUPPLY\_84 LRV, 1.8 A LOAD 6

SUPPLY\_85 LRV, 1.8 A LOAD 6

SUPPLY\_86 LRV, 1.8 A LOAD 6

SUPPLY\_87 LRV, 1.8 A LOAD 6

SUPPLY\_88 LRV, 1.8 A LOAD 6

SUPPLY\_89 LRV, 1.8 A LOAD 6

SUPPLY\_90 LRV, 1.8 A LOAD 6

SUPPLY\_91 LRV, 1.8 A LOAD 6

SUPPLY\_92 LRV, 1.8 A LOAD 6

SUPPLY\_93 LRV, 1.8 A LOAD 6

SUPPLY\_94 LRV, 1.8 A LOAD 6

SUPPLY\_95 LRV, 1.8 A LOAD 6

SUPPLY\_96 LRV, 1.8 A LOAD 6

SUPPLY\_97 LRV, 1.8 A LOAD 6

SUPPLY\_98 LRV, 1.8 A LOAD 6

SUPPLY\_99 LRV, 1.8 A LOAD 6

SUPPLY\_100 LRV, 1.8 A LOAD 6

SUPPLY\_6 TLV62130 4V-17 V, adj.softstart (optional), compare with TPS62130

Vout: 1.9 Move this Supply to Delete this Supply Add Load Add Supply

Recommended Sc SUPPLY\_1 SUPPLY\_2 SUPPLY\_3 SUPPLY\_4 SUPPLY\_5

Select Alternate R TLV62130RGTR

TPS62140RGTR

TPS62130RGTR

TPS54325PWP

TPS54326PWP

LM20333MH

LM22676MR-ADJ

LM22673MR-ADJ

LM20343MH

LM22670MR-ADJ

LM20323MH

LM20242MH

LM3102MH

LM22680MR-ADJ

LM25576MH

TPS54320RHIL

LM21305SQ

LM27342SD

TPS54620RHIL

TPS54622RHIL

ciency %	Footprint mm2	BOM Cost \$	BOM Count
0.824	152	\$1.25	8
0.824	152	\$1.80	8
0.824	152	\$2.25	8
0.843	239	\$1.98	11
0.843	239	\$2.03	11
0.833	400	\$2.45	12
0.725	292	\$2.84	9
0.725	305	\$2.92	10
0.807	414	\$2.40	13
0.720	305	\$2.91	10
0.787	406	\$2.39	12
0.803	414	\$2.36	13
0.782	246	\$3.39	11
0.722	320	\$2.80	12
0.759	427	\$3.42	14
0.844	288	\$2.38	16
0.850	284	\$3.01	19
0.677	212	\$2.03	11
0.885	321	\$3.54	15
0.885	321	\$3.54	15

# Move Remaining Supplies

2) Click on the "Move" drop down to specify move to supply 4

1) Do the same for the remaining supplies

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My Designs/Projects

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POWER ARCHITECT

PA\_Project\_306 (modified from 302) Rename \$15.92 89.1% 1,608 mm2 View Edit Compare Next Step: Cancel Changes Save Changes Create Project

Reset Add Source Edit Sequence

SOURCE: DC 1 18.2V, 5.412 A SUPPLY\_1 LMR1005 EV, 3.092 A LOAD #1 2.0 A

SUPPLY\_2 LMC1009-1 1.2V, 500 mA LOAD 2 100 mA

SUPPLY\_3 EV, 1.8 A LOAD 3 1.0 A

TLV62100 2.5V, 100 mA LOAD 3 100 mA

SUPPLY\_4 LPS900-2.5 2.5V, 100 mA LOAD 3 100 mA

SUPPLY\_5 1.8V, 1.8 A LOAD 4 1.0 A

TLV62100 1.8V, 1.8 A LOAD 4 1.0 A

SUPPLY\_6 1.8V, 1 A LOAD 5 1.0 A

SUPPLY\_7 LMP24210 1.8V, 1 A LOAD 5 1.0 A

SUPPLY\_8 LMC1075 1.5V, 1.8 A LOAD 6 1.0 A

SUPPLY\_7 LMR24210 High Efficiency

Vout: 1.8 Move this Supply to: Delete this Supply Add Load Add Supply

Recommended Supply: SUPPLY\_1

Select Alternate Part: SUPPLY\_2 SUPPLY\_3 SUPPLY\_4 SUPPLY\_5

LMR24210TL

TLV62150RGTR

TLV62130RGTR

TPS62141RGTR

TPS62150RGTR

TPS62140RGTR

LM22675MR-ADJ

TPS62131RGTR

TPS62130RGTR

LMR24220TL

TPS54325PWP

TPS54326PWP

LM22672MR-ADJ

LM2734VMK

LM20333MH

LM22680MR-ADJ

LM22676MR-ADJ

LM25575MH

LM5575MH

LMR12010XMK

Efficiency % Footprint mm2 BOM Cost \$ BOM Count

LMR24210TL	0.781	184	\$2.28	11
TLV62150RGTR	0.810	142	\$1.12	8
TLV62130RGTR	0.810	142	\$1.27	8
TPS62141RGTR	0.810	127	\$1.80	6
TPS62150RGTR	0.810	142	\$1.62	8
TPS62140RGTR	0.810	142	\$1.82	8
LM22675MR-ADJ	0.720	317	\$2.41	9
TPS62131RGTR	0.810	127	\$2.25	6
TPS62130RGTR	0.810	142	\$2.27	8
LMR24220TL	0.781	184	\$2.78	11
TPS54325PWP	0.863	239	\$1.98	11
TPS54326PWP	0.863	239	\$2.03	11
LM22672MR-ADJ	0.714	256	\$2.56	11
LM2734VMK	0.699	187	\$1.72	10
LM20333MH	0.866	406	\$2.45	12
LM22680MR-ADJ	0.714	269	\$2.69	12
LM22676MR-ADJ	0.716	347	\$2.64	11
LM25575MH	0.747	360	\$2.35	16
LM5575MH	0.753	388	\$3.14	14
LMR12010XMK	0.664	183	\$1.44	10

# Move 1V Supply to Source

2) Click on the "Move" drop down to specify move to Source\_DC\_1

1) Select the 1V supply

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Back New 0. FPGA Processor 1. Add Loads 2. Optimize 3. View/Edit 4. Power Supplies Assistant

POWER ARCHITECT

PA\_Project\_306 (modified from 302) Rename \$15.92 89.1% 1,608 mm2 View Edit Compare Next Step: Cancel Changes Save Changes Create Project

SUPPLY\_3 TLV62130 4V-17V, adjustable, softstart (optional), compare with TPS62130

Vout: 1 Move this Supply to Delete this Supply Add Load Add Supply

Recommended Supply\_6  
Supply\_7  
Select Alternate R Supply\_8  
TLV62130RGTR  
LMR10520XSD  
New Source

Efficiency % Footprint mm2 BOM Cost \$ BOM Count

Efficiency %	Footprint mm2	BOM Cost \$	BOM Count
0.799	147	\$1.24	8
0.634	163	\$0.82	9
0.799	147	\$1.79	8
0.615	149	\$0.85	9
0.828	249	\$1.95	13
0.643	179	\$1.72	9
0.634	172	\$1.73	9
0.852	256	\$1.96	14
0.840	246	\$2.81	10
0.860	285	\$2.13	13
0.860	285	\$2.13	13
0.799	147	\$2.24	8
0.615	158	\$1.76	9
0.860	292	\$2.14	14
0.884	303	\$3.06	10
0.743	298	\$2.13	13
0.743	374	\$2.10	13
0.847	295	\$4.40	8
0.874	253	\$2.05	17
0.501	146	\$2.31	6

# Save Changes

Click Save  
Changes button

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DESIGNS/PROJECTS

Back New 0. FPGAs/pP Add Loads 2. Optimize 3. View/Edit 4. Power Supplies Assistant

POWER ARCHITECT

PA\_Project\_306 (modified from 302) Rename \$15.92 89.1% 1,608 mm2 View Edit Compare Next Step: Cancel Changes Save Changes Create Project

Reset Add Source Edit Sequencing

SOURCE: DC 1 13.2V, 3.562 A

SUPPLY 1 LM11305 Switcher 5V, 2.4 A LOAD 1 2.40 A LOAD #1

SUPPLY 2 LM11305 Switcher 3.3V, 8.968 A LOAD 2 1.80 A LOAD #2

SUPPLY 3 LPS906-2.5 LOAD 3 2.5V, 100 mA LOAD #3

SUPPLY 4 TLV62109 Switcher 1.5V, 1.0 A LOAD 4 1.00 A LOAD #4

SUPPLY 5 LM264210 Switcher 1.5V, 1 A LOAD 5 1.00 A LOAD #5

SUPPLY 6 LM26575 Switcher 1.5V, 1.3 A LOAD 6 1.30 A LOAD #6

SUPPLY 7 LMZ10501 Switcher 1.2V, 800 mA LOAD 7 800 mA LOAD #7

SUPPLY 8 TLV62109 Switcher 1V, 1.8 A LOAD 8 1.80 A LOAD #8

SUPPLY 7 LMZ10501 1A SIMPLE SWITCHER Nano Module

Vout: 1.2 Move this Supply to Delete this Supply Delete a Load Add Load Add Supply

Recommended Solution: LMZ10501 Iout (calculated): 0.8000 Iout Max: 1

Select Alternate Regulator	Efficiency %	Footprint mm2	BOM Cost \$	BOM Count
LMZ10501SE	0.786	65	\$1.91	6
LMR10520XSD	0.691	129	\$0.66	8
LMR10510XMF	0.692	135	\$0.61	8
LMR10515XMF	0.692	135	\$0.66	8
LMR10510YMF	0.686	131	\$0.56	8
LMR10515YMF	0.686	131	\$0.61	8
LMR10520YSD	0.678	133	\$0.64	8
LM2830ZMF	0.686	131	\$1.25	8
LM2830XMF	0.692	135	\$1.30	8
LM2831ZMF	0.686	131	\$1.35	8
LM2831XMF	0.692	135	\$1.40	8
LM2831YMF	0.676	149	\$1.45	8
LM2832XMY	0.691	138	\$1.57	8
LM2832ZMY	0.678	142	\$1.55	8
LM2832YMY	0.702	193	\$1.54	8
LMR12010XMK	0.675	157	\$1.23	10
TLV62150RGTR	0.858	137	\$1.11	8
LMR12010YMK	0.641	161	\$1.41	10
TLV62130RGTR	0.858	137	\$1.26	8
TLV6280DSG	0.837	90	\$1.47	7

# Compare to Other Architectures

Click Compare button

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Back New 0. FPGA Processor 1. Add Loads 2. Optimize 3. View/Edit 4. Power Supplies Assistant

POWER ARCHITECT

PA\_Project\_306 (modified from 301) Rename \$16.11 86.7% 1,301 mm2 View **Compare** Next Step: Cancel Changes Save Changes Create Project

SUPPLY\_7 LM2854Y SIMPLIFIED

Vout: 1.9V Move this Supply to [ ] Add Load Add Supply

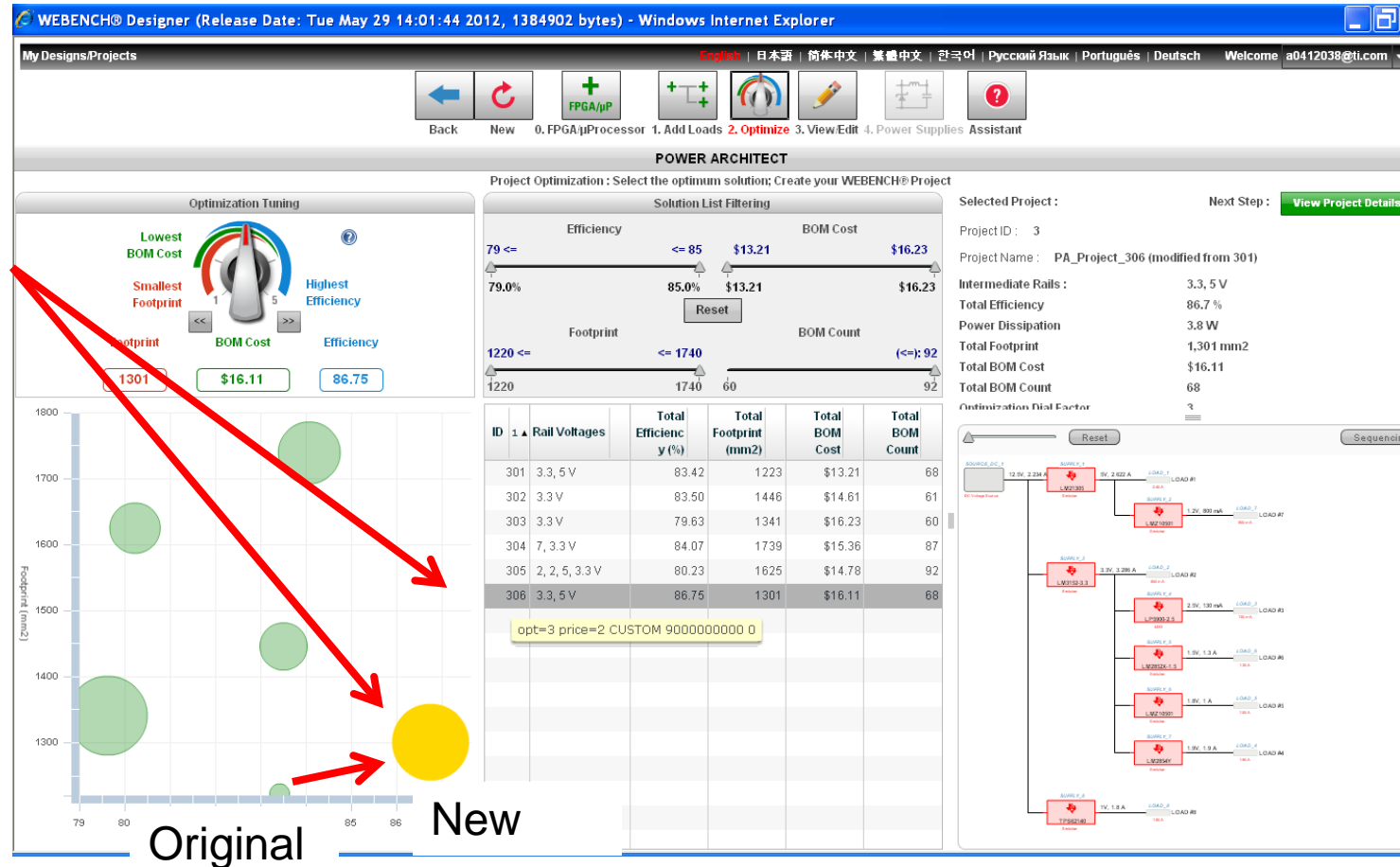
Recommended Solution: LM2854Y Iout (calculated): 1.9000 Iout Max: 4

Select Alternate Regulator	Efficiency %	Footprint mm2	BOM Cost \$	BOM Count
LM2854MH-500	0.932	259	\$2.53	11
LM2854MH-1000	0.913	249	\$2.51	10
LM20125MH	0.939	242	\$2.41	14
LM210503TZ-ADJ	0.920	294	\$3.92	9
LM20123MH	0.912	244	\$1.76	13
LM20143MH	0.923	252	\$1.77	14
LM20145MH	0.939	249	\$2.42	15
LM20134MH	0.941	242	\$2.36	14
LM20154MH	0.928	280	\$2.05	13
LM20124MH	0.928	280	\$2.05	13
LM210504TZ-ADJ	0.926	294	\$4.47	9
LM20133MH	0.929	288	\$1.79	14
LM20144MH	0.928	288	\$2.06	14
TPS53316RGTR	0.934	242	\$2.98	15
TPS54418RTET	0.937	263	\$2.86	15
LM20146MH	0.945	249	\$2.52	15
TPS54218RTET	0.906	202	\$1.97	15
LM20136MH	0.948	265	\$2.51	14
LM210505TZ-ADJ	0.926	294	\$4.87	9
TPS54318RTE	0.930	227	\$3.59	15
TPS54618RTE	0.946	261	\$3.63	15

# Compare to Other Architectures

New architecture is higher efficiency, but higher cost and larger footprint.

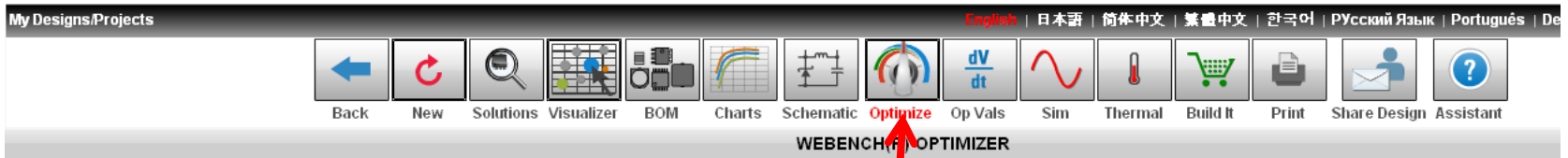
Old	New
83.4%	86.8%
\$13.21	\$16.11
1223	1301mm <sup>2</sup>



# Editing each design in a project

- Each power supply rail can be modified independently using the features of WEBENCH® Power Designer
- Each design in the project can be simulated electrically and thermally

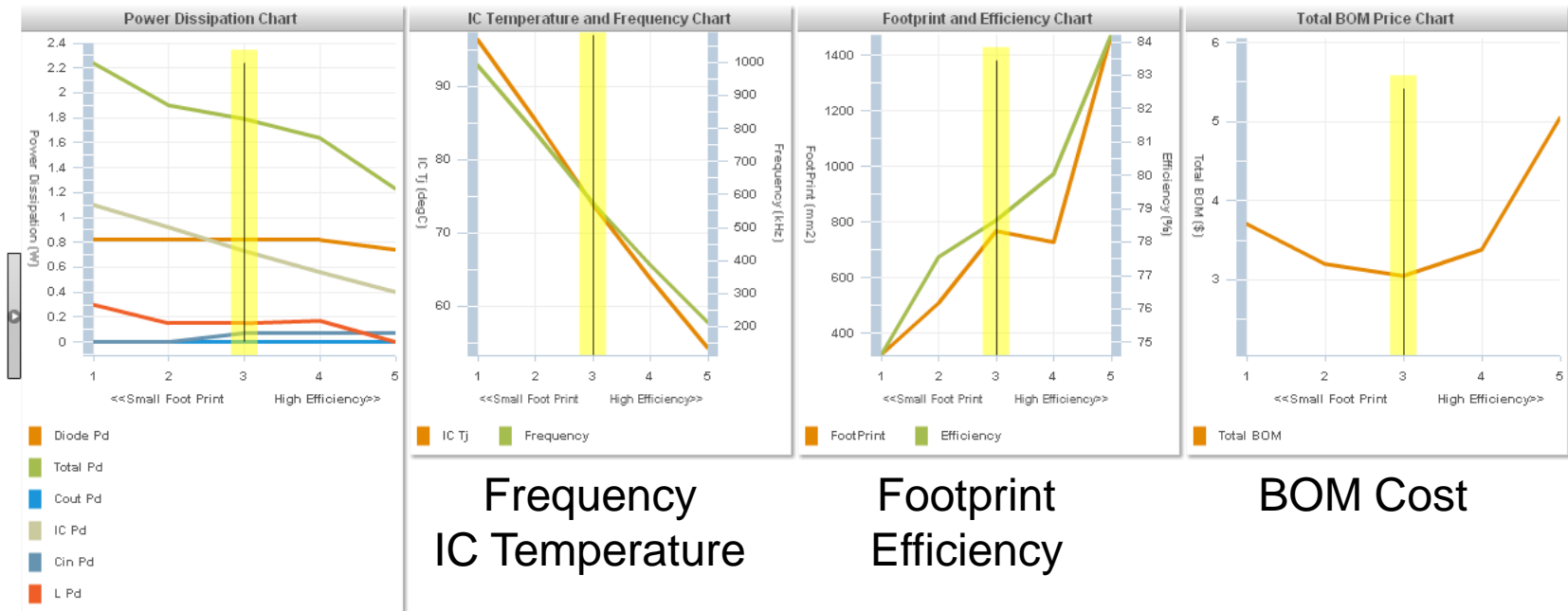
# Key Optimization Parameters Graphed



25 Designs Complete - Best 5 Designs Selected

Turn the optimization knob on the left to select your desired balance between small footprint, low price and high efficiency

Optimize page



Power Dissipation  
by Component

Frequency  
IC Temperature

Footprint  
Efficiency

BOM Cost

# Continue to Improve Each Design: View and Change Your Bill of Materials

Click Select Alternate To Change A Component

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Back New Solutions Visualize BOM Charts Schematic Optimize Op Vals Sim Print Share Design Assistant

**BILL OF MATERIALS**

Export to: ☒ Excel BOM Cost: \$3.50 \*Footprint is component footprint plus 1mm per side.

Part	Manufacturer	Part Number	Quantit	Price	Attributes	Footprint	Top View	Edit
Cb	MuRata	GRM155R71E333	1	\$0.01	Cap=33nF, ESR=00hm, VDC=25V	8	-	Select Alternate Part
Cbyp	TDK	C2012Y5V1E1052	1	\$0.01	Cap=1uF, ESR=9m0hm, VDC=25V	13	-	Select Alternate Part
Cin	TDK	C5750X7R1H1061	1	\$0.68	Cap=10uF, ESR=3m0hm, VDC=50V	60	-	Select Alternate Part
Cinx	Kemet	C0805C104K5RA	1	\$0.01	Cap=100nF, ESR=0.0640hm, VDC=50V	13	-	Select Alternate Part
Cout	TDK	C3225X5R051501	1	\$0.39	Cap=100uF, ESR=2m0hm, VDC=25V	23	-	Select Alternate Part
Ccs	MuRata	GRM155R71E123	1	\$0.01	Cap=12nF, ESR=00hm, VDC=25V	8	-	Select Alternate Part
L1	Bourns	SRU8043-6R8Y	1	\$0.36	L=6.8uH, DCR=0.0220hm, IDC=3.8A	100	-	Select Alternate Part
Rfb1	Vishay-Dale	CRCW0402976RF	1	\$0.01	Resistance=9760hm, Tolerance=1%, Power=0.063W	8	-	Select Alternate Part
Rfb2	Vishay-Dale	CRCW04023K09F	1	\$0.01	Resistance=3.09K0hm, Tolerance=1%, Power=0.063W	8	-	Select Alternate Part
Ron	Vishay-Dale	CRCW040246K4F	1	\$0.01	Resistance=46.4K0hm, Tolerance=1%, Power=0.063W	8	-	Select Alternate Part
U1	Texas Instrument	LMR24220TL	1	\$2.00		25	-	

Optimization Tuning

Lowest BOM Cost  
Smallest Footprint  
Highest Efficiency

272 \$3.50 85

Advanced Options

Soft Start Time (ms):  
1ms < 1 ms < 10ms  
User Preferred Frequency: ☐

Frequency:  
100KHz < 585.2 KHz < 1000KHz  
Update

Current Design: #1523

base_pn	LMR24220
VinMin	14 V
VinMax	22 V
Vout	3.3 V
Iout	2 A
Ta	30 degC

Name: Design 1523 - LMR24220TL

Notes:

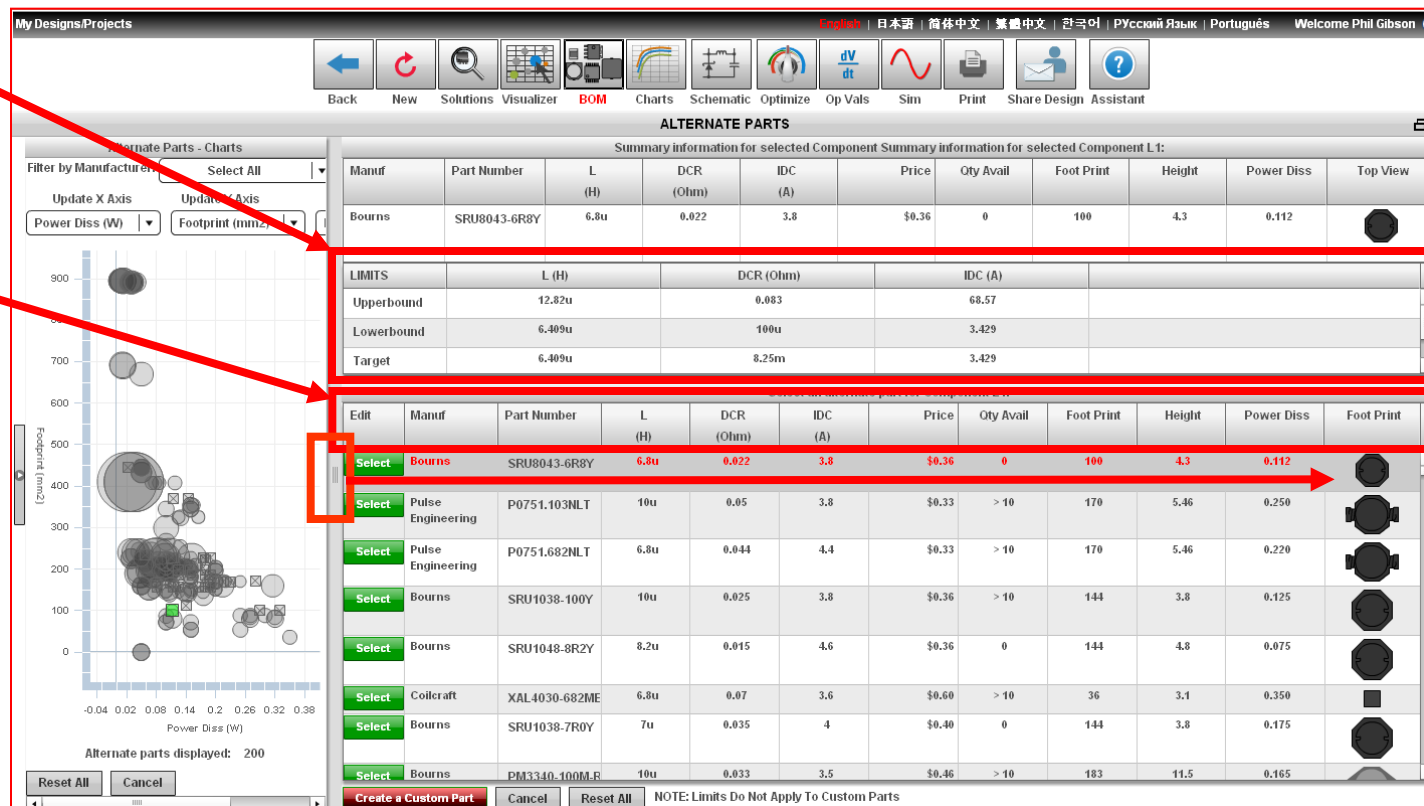
Save Name & Notes

# Evaluate and Select Alternate Components for Each Rail in the Design

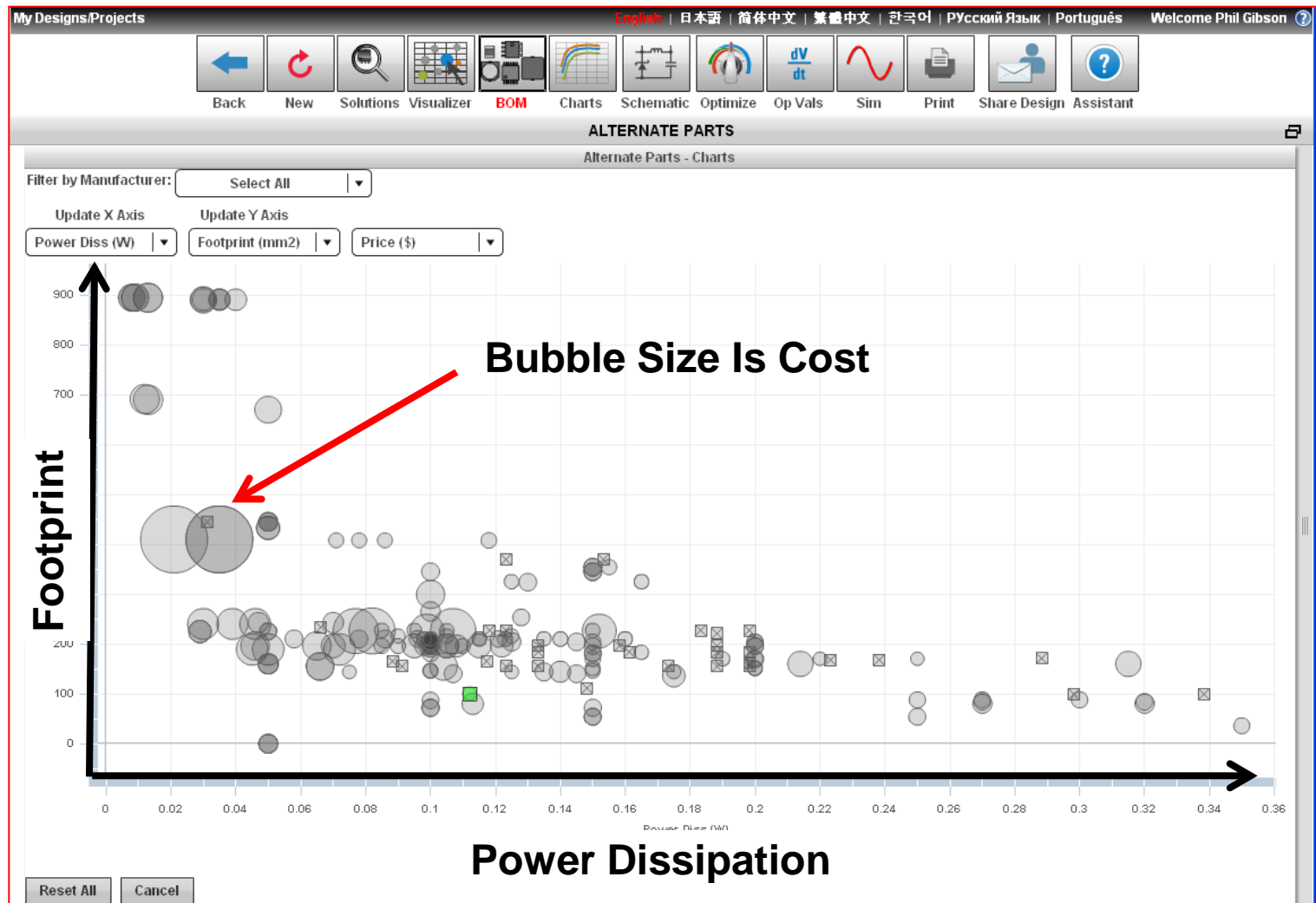
Parameter  
Specification  
Limits

Multiple  
Column Sort

Component  
Tradeoffs:  
Footprint  
Pdiss  
Price  
Performance  
Vout Ripple  
Transient Resp  
Loop Stability



# Evaluate Components – Inductor for each design in the project



# Select new component or Create a new component for your project

Filtered list based on zoom box

Click to select a component

Or create a custom component

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### ALTERNATE PARTS

Alternate Parts - Charts

Filter by Manufacturer: Select All

Update X Axis: Power Diss (W) | Update Y Axis: Footprint (mm2)

Alternate parts displayed: 200

Reset All Cancel

Summary information for selected Component Summary information for selected Component L1:

Manuf	Part Number	L (H)	DCR (Ohm)	IDC (A)	Price	Qty Avail	Foot Print	Height	Power Diss	Top View
Bourns	SRU8043-6R8Y	6.8u	0.022	3.8	\$0.36	0	100	4.3	0.112	
LIMITS										
		L (H)	DCR (Ohm)		IDC (A)					
Upperbound		12.82u	0.083		68.57					
Lowerbound		6.409u	100u		3.429					
Target		6.409u	8.25m		3.429					

Select an alternate part for Component L1:

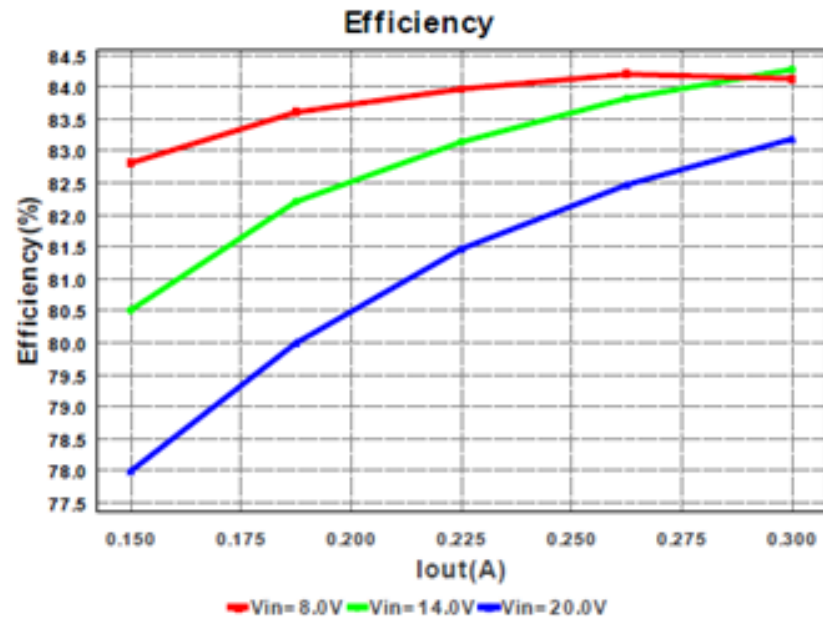
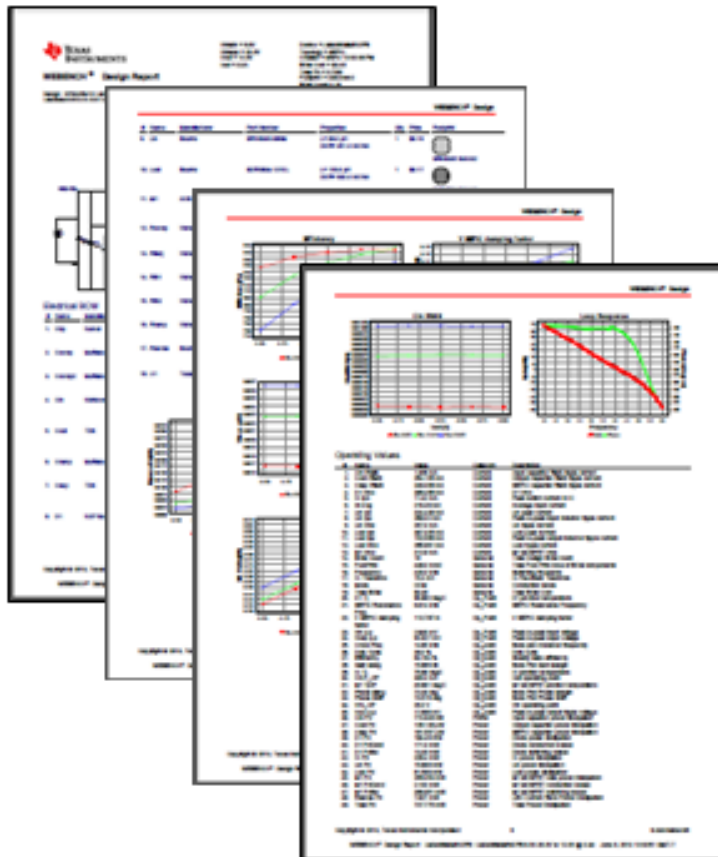
Edit	Manuf	Part Number	L (H)	DCR (Ohm)	IDC (A)	Price	Qty Avail	Foot Print	Height	Power Diss	Foot Print
Select	Bourns	SRU8043-6R8Y	6.8u	0.022	3.8	\$0.36	0	100	4.3	0.112	
Select	Pulse Engineering	P0751.103NLT	10u	0.05	3.8	\$0.33	> 10	170	5.46	0.250	
Select	Pulse Engineering	P0751.682NLT	6.8u	0.044	4.4	\$0.33	> 10	170	5.46	0.220	
Select	Bourns	SRU1038-100Y	10u	0.025	3.8	\$0.36	> 10	144	3.8	0.125	
Select	Bourns	SRU1048-8R2Y	8.2u	0.015	4.6	\$0.36	0	144	4.8	0.075	
Select	Collcraft	XAL4030-682ME	6.8u	0.07	3.6	\$0.60	> 10	36	3.1	0.350	
Select	Bourns	SRU1038-7R0Y	7u	0.035	4	\$0.40	0	144	3.8	0.175	
Select	PM3340-100MR	10u	0.033	3.5	\$0.46	> 10	183	11.5	0.165		

Create a Custom Part Cancel Reset All

NOTE: Limits Do Not Apply To Custom Parts

# Complete Power Supply Project Reporting: Automatic Generation

Your Design From The Top: Inputs, Supplies, Schematics, BOMs



# WEBENCH® Schematic Export for Projects

- TI's WEBENCH power and LED lighting design tools are the industry's leading online tools to create and optimize analog designs.
- Before: Designers create a report in PDF summarizing the WEBENCH design and manually input the schematic into the CAD tool.
- Today: With WEBENCH Schematic Export, designers can export the schematic directly to five popular CAD formats.
- Advantages:
  - Saves time
  - Reduces errors
  - Allows use of optimized WEBENCH schematics

# Create Project

Click Create Project button

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Back New 0. FPGA/µP 1. Add Loads 2. Sequence 3. View/Edit 4. Power Supplies Assistant

POWER ARCHITECT

PA\_Project\_306 (modified from 302) Rename \$15.92 89.1% 1,608 mm2 View Edit Compare Next Step: Cancel Changes Save Changes **Create Project**

Reset Add Source Edit Sequencing

SOURCE: DC 1 13.2V, 3.562 A

SUPPLY 1 LM1195 5V, 2.4 A LOAD 1 2.40 A LOAD #1

SUPPLY 2 LM1195 3.3V, 8.068 A LOAD 2 1.80 A LOAD #2

SUPPLY 3 LPS900-2.5 2.5V, 100 mA LOAD 3 100 mA LOAD #3

SUPPLY 4 TLV62100 1.5V, 1.0 A LOAD 4 1.00 A LOAD #4

SUPPLY 5 LM2602 1.5V, 1 A LOAD 5 1.00 A LOAD #5

SUPPLY 6 LM2602 1.5V, 1.3 A LOAD 6 1.30 A LOAD #6

SUPPLY 7 LMZ10501 1.2V, 800 mA LOAD 7 800 mA LOAD #7

SUPPLY 8 TLV62100 1V, 1.8 A LOAD 8 1.80 A LOAD #8

SUPPLY 7 LMZ10501 1A SIMPLE SWITCHER Nano Module

Vout: 1.2 Move this Supply to Delete this Supply Delete a Load Add Load Add Supply

Recommended Solution: LMZ10501 Iout (calculated): 0.8000 Iout Max: 1

Select Alternate Regulator	Efficiency %	Footprint mm2	BOM Cost \$	BOM Count
LMZ10501SE	0.786	65	\$1.91	6
LMR10520XSD	0.691	129	\$0.66	8
LMR10510XMF	0.692	135	\$0.61	8
LMR10515XMF	0.692	135	\$0.66	8
LMR10510YMF	0.686	131	\$0.56	8
LMR10515YMF	0.686	131	\$0.61	8
LMR10520YSD	0.678	133	\$0.64	8
LM2630ZMF	0.686	131	\$1.25	8
LM2630XMF	0.692	135	\$1.30	8
LM2631ZMF	0.686	131	\$1.35	8
LM2631XMF	0.692	135	\$1.40	8
LM2631YMF	0.676	149	\$1.45	8
LM2632XMY	0.691	138	\$1.57	8
LM2632ZMY	0.678	142	\$1.55	8
LM2632YMY	0.702	193	\$1.54	8
LMR12010XMK	0.675	157	\$1.23	10
TLV62150RGTR	0.858	137	\$1.11	8
LMR12010YMK	0.641	161	\$1.41	10
TLV62130RGTR	0.858	137	\$1.26	8
TLV62080DSG	0.837	90	\$1.47	7

# Share a Design or Project with Team Members

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**SUMMARY**

**Optimization Tuning**

Lowest BOM Cost | Smallest Footprint | Highest Efficiency

Footprint: 522 | BOM Cost: \$3.97 | Efficiency: 88

Advanced Options

Used Selected FET: ☐ Update

Current Design: #1522

IC: LM3152

VinMin: 14 V

VinMax: 22 V

Vout: 3.3 V

Iout: 2 A

ta: 30 degC

FET\_Used: II

Name: Design 1522 - LM3152MH-3.3

Notes:

Save Name & Notes

**Charts**

Efficiency

Vin=22.0000V | Vin=14.0000V | Vin=18.0000V

**Operating Values**

Modify Operating Point

Vin: 22.00V | Iout: 2.0 | Recalculate

Param	Value	Category	Description
Chn IFMS	0.72A	Current	Input capacitor RMS
Cout IFMS	0.38A	Current	Output capacitor RMS
In Avg	0.34A	Current	Average input current
Ilim	0.58A	Current	Current limit threshold
L tip	0.13A	Current	Peak-to-peak inductor ripple
SWB	2.32A	Current	Peak switch current
IC Tolerance	0.8V	General	IC Feedback Tolerance
Frequency	4610 Hz	General	Switching frequency
Pout	6.6 W	General	Total output power
Total BOM	0.397	General	Total BOM Cost
Mode	OCB	General	Conduction Mode
Footprint	522mm <sup>2</sup>	General	Total Foot Print area of BOM
BOM Count	11	General	Total Design BOM count
Efficiency	87.7%	Op. Point	Steady state efficiency
ICUT OP	2A	Op. Point	Test operating point
M2 TL	48.8degC	Op. Point	M2 MOSFET junction Tj
VIN OP	22V	Op. Point	Vin operating point
VoutOp	0.85V	Op. Point	Peak-to-peak output ripple
Duty Cycle	0.7%	Op. Point	Duty cycle
M1 TL	35.3degC	Op. Point	M1 MOSFET junction Tj

Note: The phase margin and crossover frequency are estimates. Please perform electrical simulation!

**Schematic**

Design ID: 1522

**WEBENCH® Optimizer**

Optimization Complete: Best 3 Designs Selected

Turn the optimization knob on the left to select your desired balance between small footprint, low price and high efficiency

Power Dissipation Chart

Wattage dissipation

1 2 3 4 5

Small Foot Print | High Efficiency

Total Pd | IC Pd | Chn Pd | Cout Pd

**Bill of Materials**

BOM Cost: \$3.97 \*Footprint is component footprint plus 1mm per side.

Part	Manuf.	Part No.	Q	Pr	Attributes	Fo	Top View	Edit
ChnF	Taiyo Yu	EMK2	1	\$0.0	Cap#47nF, ESR#0.00m	13		Select Action
Cbip	Kemet	C0805	1	\$0.0	Cap#100nF, ESR#0.0040 10m	13		Select Action
Chn	TDK	C2012	2	\$0.0	Cap#1uF, ESR#0.00m Oh	13		Select Action
Cout	AVX	TPSD1	1	\$0.0	Cap#100uF, ESR#0.10m	53		Select Action
Cx1	Vishay A	C0805	1	\$0.0	Cap#15nF, ESR#0.00m	13		Select Action
Cvss	Taiyo Yu	LMK2	1	\$0.0	Cap#2.2uF, ESR#0.00m	13		Select Action
L1	Bourns	SRR12	1	\$0.0	L#10uH, DCR#0.0210 10m	216		Select Action
M1	Infineon	BSC02E	1	\$0.0	VdsMax#100 V, RdsOn#40A	55		Select Action

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Click on Share Design or Share Project button

# Share the Design or Project

The screenshot displays the Texas Instruments WEBENCH Designer web application. The interface includes a top navigation bar with the Texas Instruments logo, the product name 'WEBENCH® Designer', a search bar, and a language selector. Below this is a toolbar with icons for Back, New, Solutions, Visualizer, BOM, Charts, Schematic, Optimize, Op Vals, Sim, Print, Share Design, and Assistant. The main workspace is divided into several panels: 'Optimization Tuning' on the left with a slider for 'Lowest BOM Cost', 'Smallest Footprint', and 'Highest Efficiency'; 'Charts' in the center showing a line graph of Efficiency vs. Operating Voltage; 'Schematic' on the right showing a circuit diagram; and 'WEBENCH® Optimizer' at the bottom right. A 'Share A Design' dialog box is open in the foreground, featuring a red header bar. The dialog contains the following sections: 'Share this design with:' with a text input field containing 'bill.spence@customer.com'; 'You can also choose emails from the list below:' with a list of email addresses including 'phil.gibson@nsc.com' (highlighted in red) and 'william.citajaya@nsc.com'; 'Add your notes for this design:' with a large text area; and 'Branch Code:' with a dropdown menu showing '- Please select a branch code -'. At the bottom of the dialog are 'Share this design', 'Clear', and 'Cancel' buttons. A red arrow points from the text 'Enter Recipient's Email Address And Your Note' to the email input field in the dialog box.

Enter Recipient's Email Address And Your Note


# Invitation to Open a Shared Project/Design

You forwarded this message on 10/21/2011 9:45 AM.

From: Webench Team [web@national.com]  
To: Gibson, Phil  
Cc:  
Subject: Shared TPS40210 Design#1521 to susan\_cunnington@ti.com

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## Texas Instrument's WEBENCH® Power Designer




Dear Phil Gibson,

Texas Instruments has sent an email on your behalf inviting [susan\\_cunnington@ti.com](mailto:susan_cunnington@ti.com) to use a copy of your WEBENCH® Design #1521, Design 1521 - TPS40210DGQR.

We look forward to helping you create more designs for your customers.

Regards,  
The WEBENCH Team at Texas Instruments

If you feel that this email has been sent to you in error, please send us an email at:  
[new.feedback@nsc.com](mailto:new.feedback@nsc.com)

 engineer.to.engineer,  
solving problems  
Community [e2e.ti.com](http://e2e.ti.com)

# WEBENCH® Power Designer

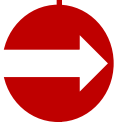


End-to-end design solutions  
Online selection, simulation and prototyping  
Dynamic design optimization based on size, cost and efficiency



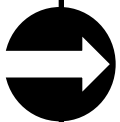
## WEBENCH Visualizer

View dozens of designs at a time to get the best solution for a single power supply  
Each design optimized for efficiency, cost and size



## WEBENCH Power Architect

System level designs for complex multiple load applications  
Provides different rail architectures  
Each system optimized for efficiency, cost and size



WEBENCH Design Tools save you time

# Thank You!

Try WEBENCH® Tools yourself:

<http://webench.ti.com>

# WEBENCH® Tool Industry Awards

- 2012 Design News Golden Mousetrap Award
  - WEBENCH System Power Architect
- 2011 EDN “Innovation of the Year”
  - WEBENCH FPGA Power Architect
- 2010 Electronic Design “Year’s Best - Power”
  - WEBENCH LED Architect
- 2010 EDN “Innovation of the Year”
  - WEBENCH Visualizer
- 2009 EDN “Innovation of the Year”
  - WEBENCH Power/LED Designer
- 2008 Electronic Products “Product of the Year”
  - WEBENCH Sensor Designer
- 2006 IEC “DesignVision” Award
  - WEBENCH Designer
- 2005 EDN “Innovation of the Year”
  - WEBENCH Active Filter Designer
- 2001 EDN “Innovation of the Year”
  - WEBENCH 3.0
- 2000 Electronic Products “Product of the Year”
  - WEBENCH 1.0



**For More Information:**

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New Customers: 800 833 3557

[www.arrownac.com/powermanagement](http://www.arrownac.com/powermanagement)